WESTERN SOUTH DAKOTA RIVER BASINS

Study Report

Based on a Cooperative Study By U.S. Department of Agriculture

Prepared by

Soil Conservation Service, Forest Service

Economics, Statistics, and Cooperatives Service

Huron, South Dakota August 1979

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Introduction

Authority

This report on the Western South Dakota River Basins is the result of a USDA cooperative study requested by the State of South Dakota, through the Water Resources Commission, 1/ the Black Hills Conservancy Sub-District, the West River Conservancy Sub-District, and the South Dakota Conservation Commission. 2/ The study was made under the authority of section 6 of Public Law 83-566, as amended, (the Watershed Protection and Flood Prevention Act).

The purpose of the study is to evaluate alternatives for the development of water and related land resources that will: (1) increase economic development through increased agricutural production, and (2) enhance environmental quality through conservation and improvement of the natural resources.

Responsibilities of USDA Agencies

The study was conducted under the direction of the USDA Field Advisory Committee (FAC) composed of Soil Conservation Service; Economics, Statistics and Cooperatives Service; and Forest Service representatives. The Soil Conservation Service representative served as chairman. This committee provided overall guidance for study activities and coordinated USDA efforts with other federal and state agencies. The committee met at regular intervals to review planning procedures and progress of the study. The sponsors also attended the FAC meetings and provided suggestions and comments.

Twenty-three county soil conservation district boards of supervisors and two conservancy subdistrict boards of directors provided input on problem identification associated with water and related land resources and suggested opportunities for development during meetings conducted in the study area.

The Soil Conservation Service has primary responsibility for preparing, publishing, and distributing the final report, and for the following items for all non-federal lands except forest land:

1. Analyzing water and related land resource problems.
2. Determining land resource management and treatment needs and potential resource developments.
3. Formulating alternative plans to satisfy component needs for national economic development and environmental quality objectives.
4. Displaying the economic, environmental, and social well-being effects.
5. Displaying and comparing the capability of the alternative plans to satisfy the needs.

1/ Currently within the SD Department of Water and Natural Resources.
2/ Currently within the SD Department of Agriculture.

The Economics, Statistics and Cooperatives Service has responsibility for the following items for all land ownership:

1. Collecting, tabulating, and describing historical and current economic and demographic data.
2. Projecting economic activity in the agricutural and related sectors for the years 1985, 2000, and 2020.
3. Preparing estimates of the economic impact of alternative plans.
4. Assisting in the preparation of the final report.

The Forest Service assists in preparing of the final report and has primary responsibility on all federal land and private forest land for:

1. Analyzing water and related land resource problems.
2. Determining land resource management and treatment needs and potential resource development.
3. Formulating alternative plans to satisfy component needs for national economic development and environmental quality objectives and displaying the economic, environmental, and social well-being effects.
4. Displaying and comparing the capability of alternative plans in satisfying the component needs.

Responsibilities of State Agencies

The sponsors are coordinators for other state agencies and departments assisting in the study. This assistance includes:

1. Providing information by type, number, and location on present status of water resource developments.
2. Providing information of source, quantity, quality, and use of existing water supplies.
3. Providing information on amounts and location of existing water rights.
4. Participating in problem identification.
5. Cooperating with the USDA Field Advisory Committee and state and local organizations in exchanging information relevant to the study.
6. Recommending opportunities for potential water and related land resource development.
7. Evaluating alternatives and assisting in selecting the recommended plan.

Acknowledgements

Acknowledgement is given to the following agencies for their assistance and cooperation in the preparation of this report.

U.S. Department of Agriculture
- Agricultural Stabilization and Conservation Service
- Farmers Home Administration
- Statistical Reporting Service
- Federal Extension Service

U.S. Department of the Interior
- Bureau of Mines
- Heritage Conservation and Recreation Service
- Bureau of Reclamation
- Bureau of Indian Affairs
- Fish and Wildlife Service

U.S. Department of the Army
- Army Corps of Engineers

U.S. Department of Commerce
- National Oceanic and Atmospheric Administration
- Office of Business Administration
- Bureau of the Census

South Dakota State Agencies, Departments, Institutions, and Sub-Divisions
- Department of Water and Natural Resources
- Department of Agriculture
- Department of Game, Fish and Parks
- South Dakota State University
- University of South Dakota
- Black Hills Conservancy Sub-District
- West River Conservancy Sub-District
- Historical Preservation Center
- State Planning Bureau
- Sixth District Council of Local Governments
- Fifth District Planning and Development Commission

The following chapter gives a brief overview of the study area and the nature of the study report. To the extent possible, in the main report only a minimum of supporting data is shown. Details are in the appendixes.

SUMMARY

CHAPTER 2

Summary

Basin Description

The Western South Dakota River Basins study area, 41,657 square miles (26,660,000 acres) in 23 counties, includes the entire area in South Dakota west of the Missouri River. Five major river basins, the Grand, Moreau, Cheyenne, Bad, and White, drain almost the entire area in an easterly direction into the Missouri River. Except for the Black Hills, the topography varies from gently rolling to rolling with occasional high buttes dotting the landscape. Streams are well defined throughout most of the area. The Black Hills, a maturely dissected domal structure, has an ancient crystalline core and flanks of steeply dipping sedimentary rocks. The hills extend 90 miles in a north-south direction and 50 miles in an east-west direction. Elevations range from 3,500 feet mean sea level (msl) to over 7,000 feet (msl). All streams are tributaries to the Cheyenne River system.

The climate is of semiarid continental type with large temperature contrast from summer to winter, and occasionally from day to day. The average annual precipitation varies from about 13 inches in the northwest to 22 inches in the southeast, and about 25 inches in the northern Black Hills. The growing season varies from 115 to 130 days in the plains area to 100 days in the higher elevations in the Black Hills.

Major land uses are cropland, rangeland, pastureland, and forest land. Rangeland and pastureland, totaling 18.8 million acres, or 70 percent of the total area, are used principally for livestock grazing. Five million acres of cropland are used primarily for wheat and domestic hay. Sixty-four percent of the 2.1 million acres of forest land is in, or near, the Black Hills. The remaining 760,000 acres in the study area are agricultural land, water areas, urban areas, and transportation.

Principal crops grown on 125,000 acres of irrigated cropland are corn and alfalfa. Belle Fourche, Angostura, and Rapid Valley irrigation projects cover about 78,000 acres. Individual or small group irrigation projects on flood plains along the major streams or adjacent to Missouri River reservoirs operate by direct diversion or pumping. Some ground water is used for irrigation in the sandhills area near the Nebraska state line.

Total population of the study area is 181,800, which represents a density of 4.4 people per square mile. Sixty percent of the population, 110,000 people, reside on farms, ranches, and in 81 small towns. There are 24,400 native Americans, 13 percent of the total population, living mostly on the five reservations in the study area. The greatest density of population is in and around the Black Hills. The population of the largest city, Rapid City, is 43,800. 1/

1/ 1970 Census of Population, U.S. Dept. of Commerce, Bureau of the Census.

Problems and Concerns

This study does not address all of the problems related to water and land resources. The principal problems examined and included in this report are:

1. Erosion exceeding tolerable soil loss limits 1/ occurs on 3 million acres. This area represents about 13 percent of the total rangeland and 17 percent of the total cropland.

2. Improper Rangeland Management - about 50 percent of the total rangeland is currently overgrazed resulting in loss of production and deterioration of the resource base.

3. Inadequate Water for Livestock and Rural Household Use - occurs on about 3 million acres of rangeland.

4. Improper Pastureland Management - about 70 percent of the total pastureland is currently overgrazed resulting in production losses and deterioration of the resource base.

5. Improper Irrigation Management - it is estimated that average yields on 60,000 acres under irrigation is 33 percent below the average yields expected when good management techniques are practiced.

6. Depletion of Wildlife Habitat - the alteration of wildlife habitat potentials associated with an increase in cropland, and a general increase in the intensity of agricultural production.

Preferred Alternative

In keeping with the concept of the U.S. Water Resources Council's "Principles and Standards for Planning Water and Related Land Resources," four alternative land use situations were analyzed. One of the alternatives emphasized economic development and one emphasized environmental quality. The preferred alternative was the one that showed the maximum net revenue while at the same time keeping soil losses within tolerable limits.

The elements and the estimated effects measured from the future without project situation to the year 2000 preferred alternate are as follows:

1/ Tolerable limits - tolerable soil loss limits are defined as maximum soil losses that can occur by erosion without significantly affecting the long term productivity of the soil.

FIG. 2-1

STUDY AREA

WESTERN SOUTH DAKOTA RIVER BASINS

SOURCE
SCS DRAWING 5,R-30 116(5-72)
LAMBERT CONFORMAL CONIC PROJECTION

REV 9-
5,R-31

1. Net revenue would increase from $205,002,000 to $444,583,000 annually. This resulted from a combination of crop rotations, land use conversions, land treatment practices, management techniques, and conservation tillage practices, all selected to maximize profit within the specified constraints. The increase in net revenue reflects an economic optimum use of agricultural resources and very extensive changes in land use, crop rotation and conservation and tillage practices. Because of the extent of these changes, it is unlikely that all of this will be totally achieved during the next 20 years. Nonetheless, they should serve as program goals.

2. Soil losses from water erosion would be reduced by over 16 million tons annually. However, soil losses from wind erosion would increase by over 1.4 million tons annually due to increased cropland acreage.

3. Land Use changes in acres

Cropland	+ 1,425,624
Rangeland	- 1,291,673
Pastureland	- 133,951

4. Crop Production changes

Corn (Bu.)	+ 1,449,491
Corn-Silage (Tons)	+ 2,949,864
Sorghum (Bu.)	+ 7,006,700
Sorghum-Silage (Tons)	- 32,577
Wheat (Bu.)	+43,876,686
Oats (Bu.)	+12,137,318
Alfalfa (Tons)	+ 105,201
Other Hay (Tons)	- 397,340
Range & Pasture (AUM)	+ 3,445,031

5. Tillage Methods changes in acres

Conventional	- 1,341,166
Conservation	+ 3,818,053

6. Land Treatment Measures changes in acres

No treatment	- 4,215,600
Contouring	+ 28,222
Windstrip-Windbreak	+ 957,018
Contour Stripcropping	+ 181,345
Terraces	+ 4,474,640

7. Rangeland Treatment changes in acres

Continuous Heavy Use	- 7,534,792
Continuous Use	- 8,391,505
Planned Grazing System	+14,570,989

8. Annual Land Treatment Cost changes in dollars

Cropland	+19,415,800
Rangeland	+ 4,969,200
Pastureland	- 588,300

Implementation

Several USDA programs are available for financial assistance to individual landowners and organized groups. To accomplish the land treatment and management measures, an intensive information program will be implemented. The sponsors, through the county soil conservation districts and other local units of government, will provide the necessary technical assistance, if funds are available for qualified personnel.

PROBLEMS AND CONCERNS

CHAPTER 3

Problems and Concerns

Problem Identification

Problems were initially identified from written statements provided by each sponsoring agency. A number of meetings were held with representatives of conservation districts, several state agencies, and other concerned groups during the problem formulation stage. These were discussed and clarified at meetings with the sponsors and basin staff members. The supervisors of each conservation district were sent questionnaires regarding any problems or concerns in their district. These were then reviewed with each district board, county extension agent, and local SCS personnel. State and Federal wildlife agencies, conservation groups, and environmental groups were interviewed for their inputs. These people were helpful in expressing the local concerns throughout the study area.

The problems were quantified from data in the 1967 Conservation Needs Inventory, the Missouri River Basin Comprehensive Framework Study, the South Dakota State Water Plan, available local data, and other applicable published data. As the problems were analyzed and reviewed by the Field Advisory Committee and the sponsors, it was agreed the study should be limited to water and land related resource concerns that could be addressed by the U. S. Department of Agriculture. These are listed in Table 3-1, and discussed in detail following the table. Data displayed for the years 1975 and 2000 represent present conditions and expected future without project conditions.

The future without project conditions displayed in table 3-1 reflect the effects of land treatment due to the on-going programs and the expected changes in land use. For example, sheet and rill erosion are expected to increase due to an expected increase of 500,000 acres of cropland. The tables in Chapter 5 display the effects of various degrees of treatment, and management combined with changes in land use.

Table 3-1 - EXPECTED CHANGES IN PROBLEMS AND CONCERNS BY YEAR 2000 1/

	Problems or Concerns	Units	Present Conditions Year-1975	Without Project Conditions Year-2000
1.	Erosion and Sediment			
	(a) Sheet, Rill, and Wind Erosion	Avg. Ann. Tons	38,580,000 2/	38,812,000 2/
	1. Sediment delivered to streams	Avg. Ann. Tons	3,860,000	3,881,000
	(b) Gully and Streambank Erosion	Avg. Ann. Tons	50,300,000	50,300,000 3/
	1. Sediment delivered to streams	Avg. Ann. Tons	33,870,000	33,870,000 3/
	(c) Total Erosion	Avg. Ann. Tons	88,880,000	89,112,000
	1. Total Sediment delivered	Avg. Ann. Tons	37,730,000	37,751,000
	(d) Acres Exceeding Soil Loss Limits	Acres	3,071,888	2,990,260
2.	Improper Rangeland Management			
	(a) Continuous heavy use	Acres	7,806,747	7,534,792
	(b) Needs reseeding	Acres	1,348	64,660
3.	Inadequate Water for Livestock and Rural Household Use	Acres	3,000,000	3,000,000 3/
4.	Improper Pastureland Management	Acres	253,450	277,484
5.	Inefficient Irrigation Management	Acres	60,000	60,000 3/
6.	Alteration of Wildlife Habitat			
	(a) Farmland Wildlife 4/	% Developed 5/	50	57
	(b) Rangeland Wildlife 4/	% Developed 5/	62	51

1/ No federal lands included in this table.
2/ Includes the sheet and rill erosion shown in tables 5-2 and 5-3 plus 10% added for rock outcrops.
3/ Changes are expected by year 2000, but procedure for making reliable projections are inadequate.
4/ See Appendix D for an explanation of these terms.
5/ Percent developed for wildlife refers to the degree (percent) to which lands have a development potential for wildlife. The ultimate potential would be 100 percent under wildlife land use and management.

1. Erosion and Sediment
   The source of the sheet, rill, and wind erosion shown in table 3-1 is, rangeland, 51 percent; cropland, 38 percent; and the remaining 11 percent is from pastureland, grazed private forest land, and rock outcrops. The gully and streambank erosion occurs primarily on rangeland. Refer to figure 3-1 for major water erosion areas.

   Although sheet, rill, and wind erosion account for 43 percent of the gross erosion, this source only contributes 10 percent of the total sediment that is delivered to live streams and reservoirs. It is estimated that 90 percent of the total sediment delivered comes from gully and streambank erosion. (See figure 3-2)

   Gully and streambank erosion occurs throughout the study area, but is particularly severe in the sharp, steep breaks adjacent to the Missouri River and other major streams. These areas have erosive soils, unstable banks, and sparse vegetation.

   The acres exceeding tolerable soil loss limits are probably of equal or greater concern than the average annual tons of erosion. Table 3-1 shows more than 3 million acres exceeding the tolerable soil loss limits. This area where tolerable limits are exceeded represents about 13 percent of the total rangeland and about 17 percent of the total cropland. Most of this rangeland acreage is overgrazed and occurs on Soil Resource Groups (SRG's) 1/ that have tolerable soil loss limits of less than 3 tons per acre. Most of this cropland occurs on soils that have tolerable limits of 5 tons per acre.

2. Improper Rangeland Management
   Almost half of the total rangeland is in continuous heavy use and is being overgrazed. The range condition is poor on a portion of rangeland and needs to be reseeded. (See table 3-1)

   When rangeland is overgrazed, the vigor of the taller, more palatable plants is reduced and the less palatable, low growing plants increase in abundance. As the range condition deteriorates, forage production decreases, surface water runoff increases, and erosion increases.

3. Inadequate Water for Livestock and Rural Household Use
   About 3 million acres of rangeland have such limited water supplies that adequate range management cannot be accomplished. Many farmers and ranchers in these areas haul water for household use.

1/ Soil Resource Groups (SRG's) - Each group is an aggregate of soil capability units identified in the 1967 Conservation Needs Inventory (CNI). Aggregation into the 37 SRG's for this study are based on similarities in use, response to management, production, and precipitation-evaporation relationships.

These areas occur throughout the study area where erosion and sediment rates are high and stock ponds are not a dependable source of water because sediment fills them within a few years. Shallow wells are usually not a dependable source because shallow aquifers either are not present, have poor quality water, or fail to yield water during drought periods. Water may be obtained from deep wells but the development of these wells is often too costly for the individual farmers or ranchers.

4. Improper Pastureland Management
   The pastureland acreage shown in table 3-1 is in continuous heavy use. This indicates that about 70 percent of the total pastureland is being overgrazed. Continuous overgrazing of the introduced grasses and legumes reduces the forage production for livestock. In severe cases this also increases surface runoff and erosion.

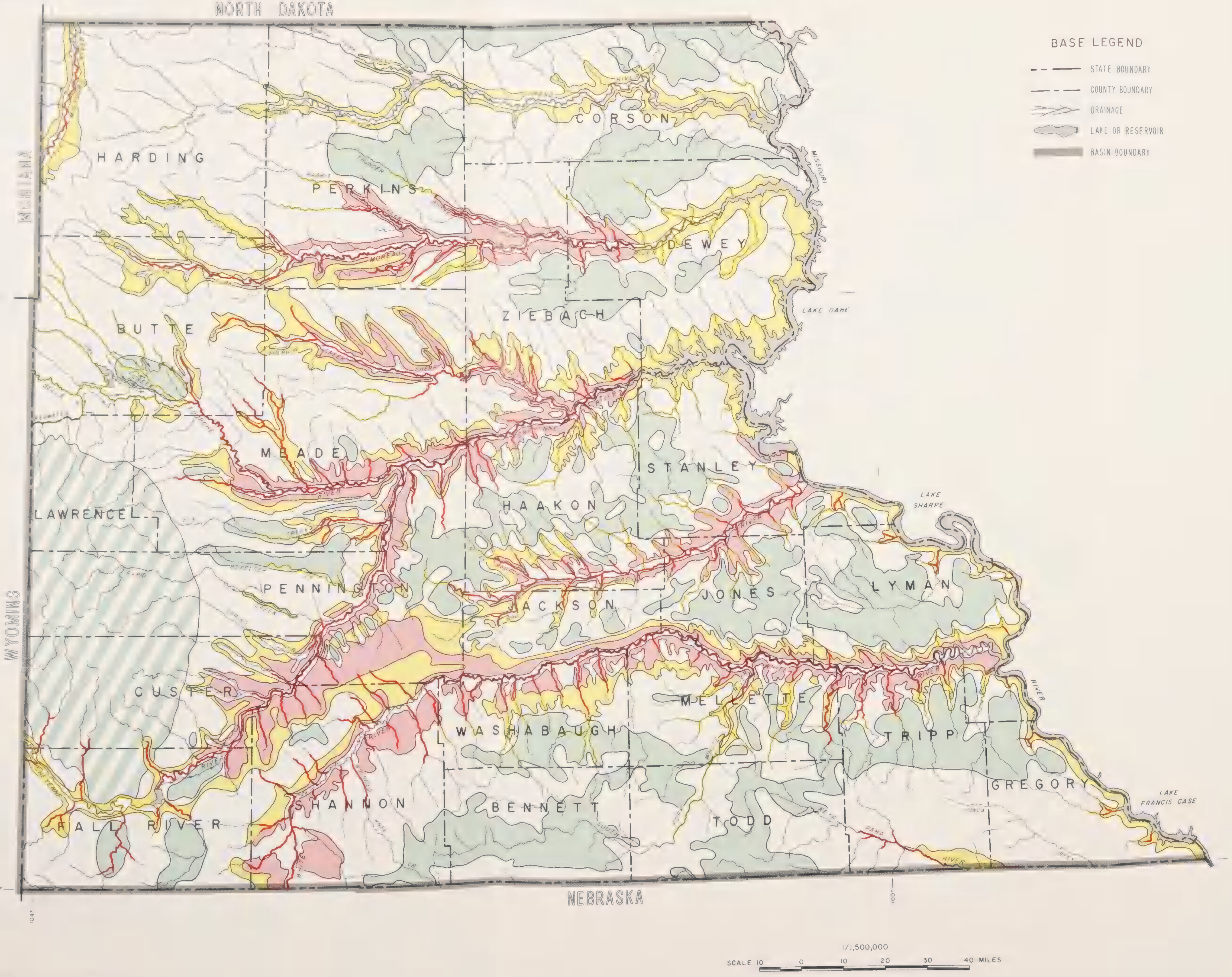
5. Inefficient Irrigation Management
   There are about 125,000 acres of irrigated land in the study area. 1/ Crop yields vary a great deal with individual irrigators. It is estimated that the average yields on 60,000 acres is 33 percent below the average yields where good management is practiced.

   These lower yields are due to inefficient use of irrigation water, fertilizers, pesticides, and failure to adopt other technological advances such as more efficient irrigation methods, improved seed varieties, new tillage methods, planting techniques, etc.

6. Alteration of Wildlife Habitat
   The contribution of private lands to the production of wildlife is highly significant in the study area. However with changes involving land being used and managed for agricultural production, habitat favorable for wildlife species change, diminishing for some species and increasing for others. It is generally felt that as agricultural production continues to intensify, wildlife production and hunting decreases. Table 3-1 shows rating potential for Farmland and Rangeland Wildlife for current conditions and an estimate for ongoing future conditions. These "Percent Developed" ratings are based on a land use factor and a management factor. Factors involved in the wildlife evaluation system are identified in Chapter 4.

7. Other Concerns
   Various other concerns were identified during the study. A number of these concerns can be solved at the local level with existing programs or through other governmental agencies. The Field Advisory Committee in consultation with the sponsors decided not to address the following concerns in this study:

1/ 1967 Conservation Need Inventory



BASE LEGEND

STATE BOUNDARY
COUNTY BOUNDARY
DRAINAGE
LAKE OR RESERVOIR
BASIN BOUNDARY

WATER EROSION LEGEND

GULLY AND STREAM BANK EROSION PREDOMINANT OVER SHEET AND RILL EROSION (PRIMARILY RANGELAND)
- SEVERE EROSION (> 8 TONS ACRE YEAR)
- MODERATE EROSION (1.5 TO 8 TONS ACRE YEAR)
- SLIGHT EROSION (< 1.5 TONS ACRE YEAR)

SHEET AND RILL EROSION PREDOMINANT OVER GULLY AND STREAMBANK EROSION (PRIMARILY CROPLAND)
- MODERATE EROSION (1.5 TO 8 TONS ACRE YEAR)

GULLY AND STREAMBANK EROSION GENERALLY PREDOMINANT OVER SHEET AND RILL EROSION (PRIMARILY FORESTLAND)
- SLIGHT EROSION (< 1.5 TONS ACRE YEAR)

EROSION RATES VARY CONSIDERABLY WITH CHANGES IN VEGETATIVE COVER, SOIL STRUCTURE AND TEXTURE, TOPOGRAPHY CLIMATE AND LAND USE AREAS TOO SMALL TO BE SHOWN ON A MAP OF THIS SCALE ARE FOUND WITHIN EACH OF THE ABOVE CATEGORIES WHICH MAY HAVE GREATLY DIFFERENT EROSION RATES THAN ARE SHOWN FOR THAT CATEGORY ON THIS MAP—STEEPLY SLOPING EXPOSURES OF SILTS AND CLAYS SUCH AS IN THE BADLANDS, MAY SHOW EROSION RATES OF FROM 10 TO 100 TONS ACRE YEAR AND SOME INTERNALLY DRAINED SHALLOW DEPRESSIONS MAY SHOW EROSION RATES LESS THAN 0.3 TONS/ACRE/YEAR

- SEVERE STREAMBANK EROSION
- MODERATE STREAMBANK EROSION
- SLIGHT STREAMBANK EROSION

NO EROSION RATES WERE ESTIMATED FOR THESE CATEGORIES BECAUSE OF THE HIGH VARIABILITY WITHIN EACH CATEGORY

THIS MAP WAS PREPARED BY USDA-SCS, HURON, SOUTH DAKOTA. BECAUSE OF THE QUALIFICATIONS CITED ABOVE THIS INFORMATION SHOULD ONLY BE USED FOR GENERAL PLANNING PURPOSES AND **NOT FOR DESIGN PURPOSES AT INDIVIDUAL LOCAL SITES.**

FIG. 3-1
WATER EROSION MAP
WESTERN SOUTH DAKOTA RIVER BASINS

SOURCE
SCS DRAWING 5,R-30,116(5-72) AND
INFORMATION FROM FIELD TECHNICIANS
LAMBERT CONFORMAL CONIC PROJECTION

USDA-SCS-LINCOLN, NEBR 1978
6-26-78
5,S-36,962

RESERVOIR IDENTIFICATION NUMBER (2)	NAME	LOCATION SEC	TWP	R	SEDIMENT CONTRIBUTING AREA (MI2)	SEDIMENT YIELD (3) (TONS MI2/YR.)
1	HAYES LAKE	29	5N	26E	43.29	142
2	W-1	9	14N	4E	1.73	280
[illegible]	W-2	8	13N	5E	0.18	650
[illegible]	W-4	21	14N	7E	0.16	110
[illegible]	W-6	10	14N	9E	0.05	1110
[illegible]	W-7	14	13N	9E	0.25	170
[illegible]	W-8	18	13N	7E	0.25	1070
[illegible]	W-10	27	12N	1E	0.44	1480
[illegible]	W-11	34	12N	1E	0.25	2360
[illegible]	W-12	35	9N	7E	0.14	4950
11	W-15	3	7N	8E	0.18	1200
37-1a	ELKINS STOCK POND NO. 1	21	6N	26E	0.57	144
[illegible]	ELKINS STOCK POND NO. 2	21	6N	26E	0.33	108
[illegible]	LAND UTILIZATION PROJECT 226-1	7	109N	79W	0.20	1150 (1)
[illegible]	LAND UTILIZATION PROJECT 226-2	32	109N	77W	0.98	598 (1)
[illegible]	LAND UTILIZATION PROJECT 226-4	19	108N	79W	0.74	703 (1)
[illegible]	LAND UTILIZATION PROJECT 226-6	29	109N	78W	2.54	372 (1)
[illegible]	LAND UTILIZATION PROJECT 226-13	29	3N	31E	0.16	680 (1)
[illegible]	LAND UTILIZATION PROJECT 226-21	24	108N	79W	0.23	1815 (1)
[illegible]	LAND UTILIZATION PROJECT 226-22	2	109N	79W	0.51	260 (1)
[illegible]	LAND UTILIZATION PROJECT 226-25	[illegible]	106N	78W	0.14	1042 (1)
[illegible]	LAND UTILIZATION PROJECT 226-31	26	108N	79W	0.22	1122 (1)
[illegible]	LAND UTILIZATION PROJECT 226-32	9	107N	78W	0.47	663 (1)
[illegible]	LAND UTILIZATION PROJECT 226-34	21	1N	31E	1.21	578 (1)
[illegible]	LAND UTILIZATION PROJECT 226-35	32	107N	79W	0.50	823 (1)
[illegible]	LAND UTILIZATION PROJECT 243-1	17	107N	79W	0.11	1058 (1)
[illegible]	LAND UTILIZATION PROJECT 243-2	27	107N	79W	0.13	2880 (1)
[illegible]	LAND UTILIZATION PROJECT 243-5	21	107N	78W	0.07	913 (1)
[illegible]	LAND UTILIZATION PROJECT 243-6	9	1N	31E	0.12	619 (1)
[illegible]	LAND UTILIZATION PROJECT 243-10	7	106N	79W	0.53	290 (1)
[illegible]	LAND UTILIZATION PROJECT 243-11	33	1N	31E	0.34	347 (1)
[illegible]	W-14 (ANDERSON)	4	7N	8E	0.54	3320 (1)
[illegible]	W-9 (SMEENK)	32	12N	8E	1.27	2580
38-5	ANGOSTURA RESERVOIR	20	8S	6E	9093.00	181
38-9	CANYON LAKE	8	1N	7E	66.35	50
[illegible]	NEW UNDERWOOD DAM	30	2N	11E	2.94	231
[illegible]	KAUBISCH	29	14N	12E	1.97	157
[illegible]	CLARK	5	15N	14E	2.56	196
[illegible]	WENNER	8	22N	19E	0.49	392
[illegible]	COLE	9	20N	13E	2.21	379

(1) BASED ON ESTIMATED DRY VOLUME WEIGHT OF 65 POUNDS PER CUBIC FOOT

(2) 37-, 38- AND 39- NUMBERS REFER TO PUBLISHED SUMMARY RESERVOIR SEDIMENT DEPOSITION SURVEY SHEETS (USDA MISCELLANEOUS PUBLICATIONS)

(3) THIS SEDIMENT YIELD IS MEASURED SEDIMENT DEPOSITION IN A RESERVOIR. TRAP EFFICIENCY OF RESERVOIRS IS NOT CONSIDERED.

× RESERVOIR SEDIMENTATION SURVEYS
37-1 RESERVOIR IDENTIFICATION NUMBER
153 SEDIMENT DEPOSITED (TONS PER SQUARE MILE OF CONTRIBUTING DRAINAGE AREA PER YEAR)

309 ● TONS OF SUSPENDED SEDIMENT AND BEDLOAD PER SQUARE MILE OF CONTRIBUTING DRAINAGE AREA (WITHIN SOUTH DAKOTA) PER YEAR FOR EACH OF THE MAJOR BASINS. COMPILED FROM USGS SUSPENDED SEDIMENT DATA AND ADJUSTED FOR BEDLOAD AND DRAINAGE AREA BY USDA-SCS.

897 ▲ ESTIMATED TONS OF SEDIMENT YIELD PER SQUARE MILE OF CONTRIBUTING DRAINAGE AREA (DIRECTLY DRAINING TO MAINSTEM RESERVOIRS) PER YEAR. FROM THE MISSOURI RIVER BASIN COMPREHENSIVE FRAMEWORK STUDY, SEDIMENTATION WESTERN DAKOTA TRIBUTARIES (1968).

FIG. 3 - 2

SEDIMENT YIELD MAP

WESTERN SOUTH DAKOTA RIVER BASINS

SOURCE
SCS DRAWING 5,R-30,116 (5-72) AND
INFORMATION FROM FIELD TECHNICIANS
LAMBERT CONFORMAL CONIC PROJECTION
USDA SCS LINCOLN NEBR 1978

10-6-78
5,S-37,047

a. Floodwater Damages

The most serious flood damages have occured in the urban areas within or near the Black Hills. The 1972 flood in Rapid City caused an estimated $100 million damages and a loss of 236 lives. Floodplain management and zoning, warning systems, and the Flood Insurance Program are being utilized to help alleviate urban flood hazards. Flooding in rural areas is considered minor.

b. Pollution from Municipal, Industrial, and Feedlot Sources

Pollution of streams, lakes, and reservoirs from municipal, industrial, and feedlot sources is a minor problem due to low surface runoff and the small number of commercial feedlots. Man-caused pollution is generally a minor problem except for industrial wastes which, until recently, have been entering Whitewood Creek in large quantities. The South Dakota Department of Environmental Protection (DEP) is primarily responsible for enforcement of air and water quality standards. Detailed studies by the Sixth District Council of Local Governments and DEP are addressing water quality problems and solutions.

c. Inadequate Water-Based Recreational Facilities

There are approximately 164,000 acres 2/ of water suitable for a variety of water based recreational activities. Increased demand for suitable recreational facilities is anticipated in the Black Hills and other smaller communities in the western portion of the study area. The largest surplus of water is available to people living in the eastern one-third of the study area adjacent to the Missouri River reservoirs. The South Dakota Department of Wildlife, Parks, and Forestry will provide leadership in determining and meeting future recreational requirements.

d. Inadequate Municipal Water Supplies

The demand for municipal water is expected to increase in relation to expected expansion of population and industrial growth. Inferior quality ground water often supplies the municipal and industrial needs for many communities. The requirements for the Black Hills communities are met by both surface runoff and ground water of generally good quality. Increased mining and manufacturing activity in the Black Hills would have a major impact on future demands for municipal water. The USDA will be involved with municipal water supplies only when in conjunction with related USDA programs.

2/ "1975 South Dakota Comprehensive Outdoor Recreation Plan", January 1979.

e. Water Loss through Sinkholes

Surface water used for agricultural, municipal, and industrial purposes often originates in various streams in the Black Hills. These streams drain the impermeable Precambrian core of the Black Hills and lose an average of 44 cfs to sinkholes. [3] These sinkholes function as ground water recharge inlets. Much of the streamflow taken into the sinkholes returns to the surface as large springs from bedrock bordering the Hills.

f. Surface Mining

There are no active coal mines, and less than 1,000 acres of abandoned coal mines in the study area. Stripable deposits of coal occur in several counties in the northern part of the study area. Surface mining of bentonite occurs in Butte County. There are small sand and gravel operations throughout the study area. There is potential for surface mining of uranium and other minerals in the Black Hills.

Unless properly managed, surface mining in western South Dakota could result in soil erosion, surface water pollution, and loss of capacity for agricultural production. Studies conducted through the Rural Abandoned Mine Program (RAMP) indicate a problem in only three counties: Dewey, Perkins, and Ziebach. The rehabilitation of these mines has been given a low priority by RAMP.

g. Saline Seeps

Saline seeps are surface outcrops of salty underground water which occur in spotted areas, mostly associated with cropland. They form where water is not used by plants, moves through salty surface soil, collects below the root zone, and moves laterally along a relatively impermeable layer. When this impermeable layer approaches the surface, water also moves to the surface, evaporates, and leaves a characteristic salt crust that kills useful vegetation.

Summer-fallow is a significant factor in development and growth of many saline seeps because of long periods when water is stored in the soil profile without plant growth to use it. Seeps may also develop as a result of seepage from irrigation canals and field ditches, or of overirrigation. They frequently occur in rangeland, downstream from stockwater dams.

3/ Report of Investigations No. 107 Large Springs in the Black Hills South Dakota and Wyoming by P.H. Rahn and J.P. Gries, South Dakota School of Mines and Technology, Rapid City, South Dakota in cooperation with the Water Resource Institute under Project N. A-021-SDAK, South Dakota State University, Brookings, South Dakota.

Saline seeps occur from the Dakotas north into Canada, affecting up to 1.5 percent of the cropland. The number and extent of seep areas has increased rapidly in recent years. The Old West Regional Commission has awarded a grant to the Water Resources Institute of South Dakota State University to study this problem.

h. Urban Sprawl

Urban sprawl is evident throughout the Black Hills region. Much of this sprawl is due to lack of effective land use policies or zoning regulations. The increased demand for homes and cabins in the Black Hills results in a variety of additional problems such as police and fire protection, need for maintaining new roads, and other costs related to being located some distance from population centers. These problems will place additional pressures on local and regional governments to influence future growth within the region.

i. Mortality of Pine Trees Caused by the Mountain Pine Beetles

Problems resulting from mountain pine beetle activity in the Black Hills were among the concerns identified. Information on outbreak areas and beetle prevention and suppression activities are available at the Black Hills Forest supervisors office in Custer, South Dakota and at the State Forester's office, Department of Wildlife, Parks and Forestry, Pierre, South Dakota.

ANALYTICAL SYSTEMS

CHAPTER 4

Analytical Systems

Foreword

The problems and concerns are varied and cover a large geographic area; therefore a large data base was required. It was concluded that automatic data processing was the most efficient method of analysing the problems and arriving at alternatives. The major emphasis of this study is to evaluate environmental and economic tradeoffs associated with land use conversion, soil loss, and level of production of major agricultural commodities.

Linear Program Analysis

The mathematical technique used to study the tradeoffs was linear programming (LP). This is a technique for determining the optimum allocation of limited resources to obtain a particular objective where there are alternative uses for the resources. Maximum profit was selected as the objective for the operation of the LP. The acceptability of this objective function is improved if constraints are imposed on the nature and magnitude of change allowed in the operation of the system. The LP Model is based upon assumed reasonable estimates of the economic choices agricultural producers will make over time.

Input-Output Analysis

Given a series of LP solutions which quantify soil loss and net revenue, further analyses are in order. The magnitude of monetary differences derived in the series of LP solutions can be further analyzed to estimate the direct, indirect, and induced economic effects on the region. Input-output (I-O) analysis was used to develop these estimates of changes in the regional economy. The principle of this technique rests on the high degree of interdependence among producing sectors. Each economic sector not only produces goods or services but is a consumer as well, purchasing other goods and services for use in the production process. The net effect is that changes in net revenue between LP solutions may be further multiplied within the region by successive rounds of spending these dollars for goods and services.

Description

The analytical systems are described to provide orientation to the methodology so that the report is more readily understood. Detailed descriptions of the systems and input data appears in the appendices.

Land Base

These systems incorporate land use, treatment needs, and soils data derived from the 1967 Conservation Needs Inventory (CNI). The data were used to simulate the current situation. Acreages of all privately owned lands in the major use categories of cropland, pastureland, rangeland, and grazed noncommercial forest land were included in the model.

Soil capability units were condensed into 37 Soil Resource Groups (SRG's) having similar erosive, management and productive characteristics. SRG descriptions are contained in Appendix C. Computer programs were adapted to create cropping patterns for each county. The acreage of each major crop, nonirrigated and irrigated, as well as pasture, range, forest and other land was identified by SRG and county. The 1968-1972 agricultural statistical data series from the Crop and Livestock Reporting Service was the basis for establishing the acreage and production of major crops. These major crops appear in 13 nonirrigated and 3 irrigated rotations characteristic of the area. Two alternative tillage methods and five alternatives for conservation treatment were available on cropland. For pastureland, three alternative systems of management were available. In the case of rangeland and grazed noncommercial forestlands, the 37 SRG's were further condensed into 10 SRG's. Six alternative management systems were available for rangeland on the basis of each of three antecedent conditions.

Yields

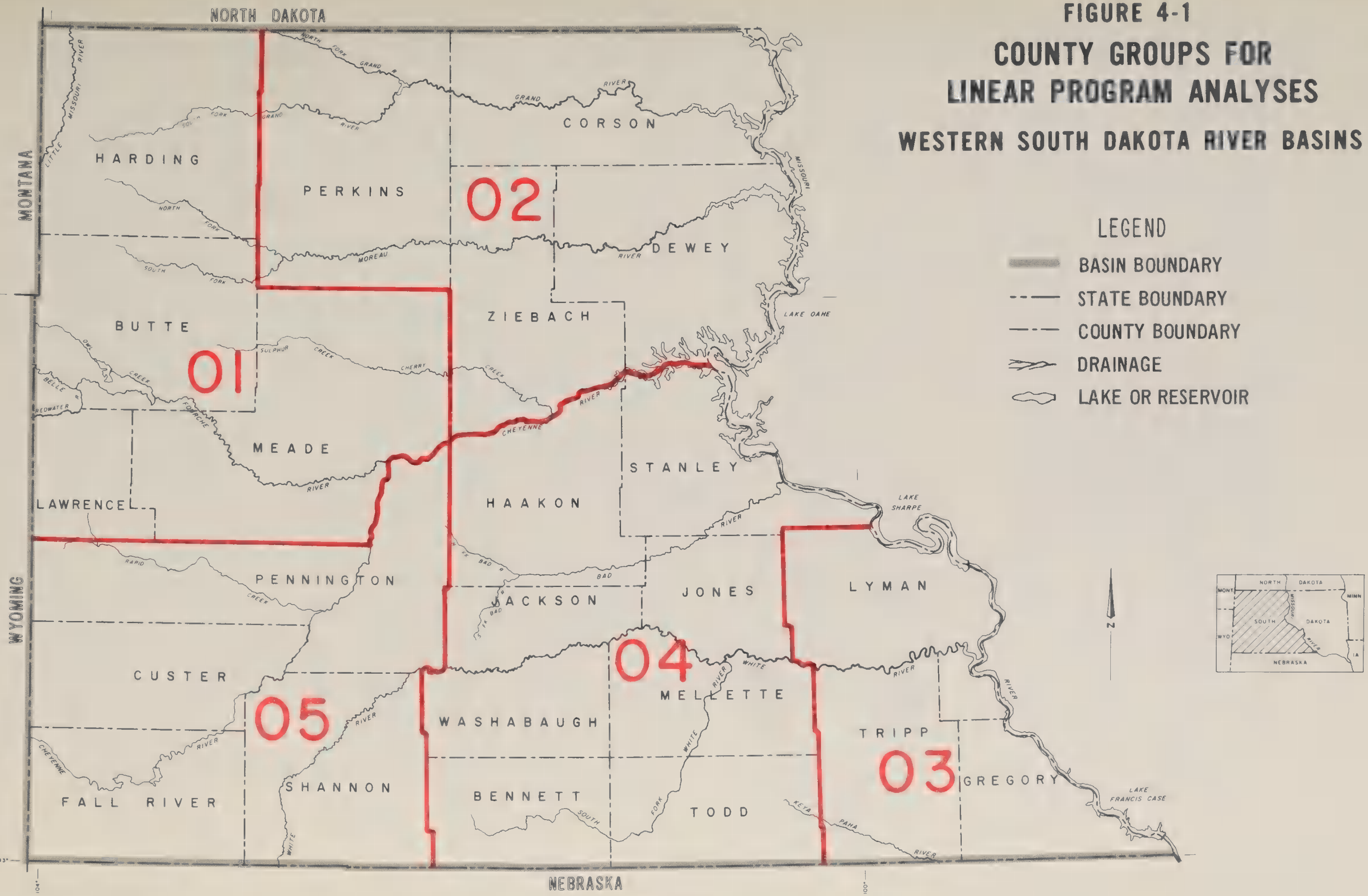
Yields of major crops, pasture, and range were computed on the basis of predicted yields under both average and high levels of management. These yields were estimated for each soil capability unit and were weighted to reflect the CNI acreages of the soil series constituent to each SRG within Land Resource Area (LRA). Yields were then normalized to conform with the average of the 5-year statistical data series for acreage and production of major nonirrigated and irrigated crops in each county.

Individual county data were merged to conform with the county groupings shown in Figure 4-1. Although the data support of the analytical systems can be readily applied to individual counties, all subsequent analyses are on the basis of county groups.

The yields were inserted into the matrix of alternative rotations, types of tillage, levels of conservation treatment and systems of management. Yields under high level of management were then used as a barometer by associating them with the best combination of practices for each SRG.

Yields were projected to 2020 as a straight line function of the combined effects of existing and new technology. SRG's were stratified in their responsiveness to technology. Factors were developed to estimate the degree to which existing technology would be implemented by 2020 and translated into yield effects on the basis of the current differential between the computed yields under average and high levels of management. The major elements of new technology will be improvements in crop varieties, improved management practices, and improvements in fertilizers and pesticides. These improvements are presumed to occur on a straight line base throughout the planning period. The estimated negative effects of excessive soil loss on yield were considered throughout the entire procedure. Detailed yield data are contained in Appendix E, a separate document which is available upon request.

FIGURE 4-1
COUNTY GROUPS FOR LINEAR PROGRAM ANALYSES
WESTERN SOUTH DAKOTA RIVER BASINS



SOURCE:
FAMILY OF MAPS S.C.S. DRWG. NO. 5,R-30,116 (5-8-72)
AND INFORMATION FROM FIELD TECHNICIANS.
LAMBERT CONFORMAL CONIC PROJECTION

7-31-78
5, N-36,997

USDA-SCS-LINCOLN, NEBR. 1978

Soil Loss

Soil losses due to the erosive forces of wind and water are separately accounted for in the LP system. The Universal Soil Loss Equation and the Wind Erosion Equation were used to estimate losses due to the respective forces. Estimated losses reflect the characteristics of each SRG as superimposed by the array of alternative rotations, tillage systems, conservation treatment on cropland and management systems on pastureland, rangeland, and grazed noncommercial forest land. These are average annual losses expressed as constants over time. Appendix F, a separate document available upon request, contains the detailed soil loss input data.

Production and Treatment Costs

Production cost budgets for the major crops are derived from available budgets prepared within the Firm Enterprise Data System (FEDS) activity of the Economics, Statistics, and Cooperatives Service (ESCS). The budgets include the variable costs of production but do not include land costs. Where no usable budgets specifically prepared for the study area were available, budgets for adjoining regions were adapted. Production costs for pasture and range as well as amortized costs for conservation treatment, tillage systems and pasture and range management systems were developed.

Basic budgets were prepared for each major crop. A computer program was prepared that would tailor these budgets to reflect net returns as they varied over time, by SRG, land treatment and rotation. Production costs were adjusted to reflect the increased use of fertilizers and pesticides. Custom hired harvesting costs on a unit production basis were computed as a function of current and projected yields. Average annual costs of irrigation development under two physiographic conditions affecting development costs on existing nonirrigated cropland were estimated. Costs of converting land use from rangeland and pastureland to cropland and cropland to rangeland and pastureland were computed as average annual rates. The net result of the implementation of these procedures, when processed through the previously mentioned computer program, consists of about 12,000 budgets listed in Appendix G. This appendix is a separate document which is available upon request. A more detailed description of production and treatment costs is contained in Appendix B.

Price Assumptions

Current normal prices of major agricultural commodities were applied for the current situation and to the year 2020. These are Water Resources Council current prices normalized for short-term fluctuations as of August 1976. Values placed on unit production of silage, and forage from pastureland and rangeland were computed on the basis of nutritional quality and regional market prices for appropriate classes of livestock.

Application

The data base described is the basis for the generation of the solutions shown in Table 1. The maximum profit objective of the LP is implemented for all solutions with the exception of the present and future without project conditions for year 2000. In these instances, all land use, rotations, tillage, land treatment, and management systems were prespecified based on the knowledge and estimates of the current use and management of the study area. CNI data were used as reference points where possible and appropriate. The year 2000 Type I solution represents the best estimate of the projected circumstance with the continued operation of existing nonstructural programs.

Solution Types II through V incorporate the maximum profit objective for each of the three future time periods. Upper limits were placed on land use conversions in order to constrain that activity within reasonable ranges. Soil loss constraints ranged from no constraint through SRG tolerance levels and within 2 tons per acre per year each for wind and water erosion. The OBERS level of production specified as a minimum constraint in conjunction with Solution Type II is the projected study area share of national production based on the area's historical performance.

Table 1. Constraints To and Timing of Analytical Systems Solutions

Solution Type	Constraints: Land Use Conversion	Constraints: Soil Loss	Constraints: Production Requirements	Timing: Current	Timing: 1985	Timing: 2000	Timing: 2020
I	NA 1/	NA	NA	X		X	
II	Yes	None	Minimum OBERS 2/		X	X	X
III	Yes	None	None		X	X	X
IV	Yes	Tolerance Level	None		X	X	X
V	Yes	2 Tons/Wind 2 Tons/Water	None		X	X	X

1/ Land use conversion is not applicable in the current situation and is built into the prespecified conditions for the year 2000. Land use conversions do not occur as the result of the maximum profit objective.

2/ Projected study area share of national demand for agricultural commodities.

Appendices B and C contain the projections data pertaining to agricultural production and other economic parameters. These projections make assumptions about critical elements such as rate of population growth, level of employment, rate of technologic progress, level of export of agricultural commodities, etc. These elements have a direct bearing on the level of national demand for agricultural products in the future.

The input-output (I-O) technique is applied to the monetary differences in net revenue among the type solutions within time frames. The I-O solutions provide estimates of changes in the regional economy due to the indirect economic impacts of net revenue differentials.

Wildlife Evaluation

The wildlife evaluation included making a comparison of present and future without project conditions with three future alternatives for the year 2000. These two conditions along with three alternatives: national economic development (NED), environmental quality (EQ), and the preferred alternative, were interpreted for wildlife potentials, to include farmland wildlife and rangeland wildlife.

The concept involving kinds of wildlife was modeled after soil survey interpretation procedures where habitat ratings are made for farmland wildlife, woodland wildlife, wetland wildlife and rangeland wildlife. The land uses, and the land use rotations and management systems which were specified in the alternatives, provided the opportunity to evaluate only farmland and rangeland wildlife.

Land uses involved were cropland (dry), cropland (irrigated), hayland (permanent), pastureland (permanent) and rangeland. The relative quantities (acres) of these land uses in the five alternatives provided a "land use factor" for each alternative.

A "quality factor" for each alternative was obtained from quantitative (acreage) differences occurring in 13 dry cropland rotations, 3 irrigated cropland rotations, 1 permanent hayland management system, 4 permanent pastureland management systems, and 10 rangeland management systems.

The wildlife evaluation system from which potentials were derived is explained in Chapter 5 and Appendix D.

Evaluation

Major emphasis has been placed on the development and implementation of analytical systems to evaluate environmental and economic tradeoffs associated with the imposition of constraints to soil loss. These tradeoffs are measured in terms of total soil loss in its relationship to production performance and effects on the regional and national economies.

The input data contained in the model has certain limitations based on current rotations being utilized in the basin. For example, rotations of continuous wheat or row crops were not used in making the analysis. This, no doubt, limited the differences in land use conversions, net revenue, and soil loss that would have occurred among various alternatives.

Much additional insight could be gained through simple alterations of key assumptions and/or the data base. Through any and all such alternations the goal should continue to be the evaluation of environmental and economic tradeoffs.

Priority should be given to the ranging of values of three key factors. Commodity price assumptions, specifically that of wheat, could be ranged upward from current normal prices so that effects on land use conversion, soil loss and net revenue could be evaluated. The assumed value of forages for livestock consumption could be ranged separately or in unison with commodity price assumptions. Cost of production assumptions could be ranged upward to reflect increased costs of specific elements such as energy, fertilizer and pesticides, and could be ranged in unison with the commodity price and forage value assumptions. A great many possible combinations of these three factors exist.

ALTERNATIVES

CHAPTER 5

Alternatives

The sponsors' goals for this study were in harmony with the national objectives regarding water and land resource planning for (1) national economic development and (2) environmental quality. The objective of the study was not to formulate a plan, but rather to analyze alternative situations and prepare a report that could be used as a "tool" in dealing with the political, social, economic, and environmental aspects of future planning.

The alternatives were formulated with two specific objectives in mind: (1) to increase economic development through increased agricutural production, and (2) to enhance the environmental quality of the region through conservation and improvement of the natural resources.

An evaluation was made of four future land use alternatives with emphasis on evaluation of impacts on net revenue and associated soil losses. Without project conditions for 1975 1/ and 2000 were used as a base of comparison with the other four future alternatives. The characteristics of the alternatives are shown on the following page.

1/ Based on 1967 CNI land use data.

Characteristics of Alternatives

Name of Alternative	Characteristics of Alternatives			
	Meet Minimum OBERS 4/ Requirements	Maximize Net Revenue Within Given Constraints	Soil Loss Constraints Set	Land Use Conversions Allowed (Limited)
Present Conditions - 1975	No	No	No	No
Future without Project Conditions - 2000	No	No	No	No 3/
Minimum OBERS 4/	Yes	Yes	No	Yes
NED Alternative	No	Yes	No	Yes
Preferred Alternative	No	Yes	Yes 1/	Yes
EQ Alternative	No	Yes	Yes 2/	Yes

1/ Soil loss constraint set at tolerable levels.
2/ Soil loss constraint set at 2 tons each for wind and water.
3/ Land use conversions were prescribed - not based on maximizing net revenue.
4/ OBERS projections are presented as baseline or reference series for the analysis of revenue demands and development needs, and for the evaluation of the costs, benefits and economic impact of development and management programs and products. The analysis and projections were conducted by the Bureau of Economic Analysis, U.S. Department of Commerce and Economic Research Service, U.S.D.A. (Now Economics, Statistics and Cooperatives Service)

The OBERS alternative was slightly different from the other three. For this alternative the linear program (LP) was constrained to produce the quantities required to meet the regions projected share of future demand for agricultural commodities. The results of this alternative showed the economic land use and soil loss effects resulting from that prespecified production situation.

Certain basic criteria were used in selecting the alternatives evaluated in this report. For example, the national economic development (NED) alternative was the alternative that would maximize net returns with no other constraints. The resultant land use conversions, cropping rotations, management strategies, land treatments, etc., were determined through use of a linear program for that prespecified economic situation.

The environmental quality alternative limited soil loss from either wind or water at 2 tons per acre per year maximum. Again the economic effects, land use and management changes, etc., were determined using the LP for that prespecified environmental situation.

The preferred alternative was a combination of the two objectives, that is, maximizing net revenue but within tolerable soil loss constraints. The results reflected the economic and land use effects for this situation.

The differences that occur with each alternative are displayed by county groups, by study area, and by timeframe as follows:

I Net Revenue - Table 5-1
II Soil Loss - Tables 5-2, 5-3, 5-4
III Land Use Conversions - Table 5-5 through 5-11
IV Land Use Acreages - Table 5-12 through 5-15
V Production by Commodity - Table 5-16 through 5-24
VI Cropland Treatment - Table 5-25 through 5-31
VII Pastureland Treatment - Table 5-32 through 5-34
VIII Rangeland Treatment - Table 5-35 through 5-38
IX Land Treatment Costs - Table 5-39 through 5-42
X Wildlife Habitat - Table 5-43 through 5-47
XI Regional Socio-Economic Impacts - Table 5-48
XII Federal Land Sector Impacts - Table 5-49 through 5-52

NET REVENUE

Table 5-1 would suggest a potential to more than double the net revenue when comparing the four alternatives to the present and future without project conditions by 2000. The OBERS alternative would result in less net revenue than the other three alternatives, due to the large amount of hay and pasture needed to meet the livestock requirement. There is surprisingly little difference in net revenue between the EQ alternative and the NED alternative. This would result, in most cases, in the best solution from a conservation standpoint and also the most profitable alternative over a long period of time.

Table 5-1 - NET REVENUE (DOLLARS)

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	23,723,257		28,678,788	
	2	37,817,986		47,783,071	
	3	35,813,563		44,403,703	
	4	54,794,735		72,562,966	
	5	8,667,799		11,574,127	
	S. Area	160,817,340		205,002,655	
Minimum OBERS Alternative	1		30,237,404	60,163,627	70,153,651
	2		39,574,972	53,443,718	57,381,325
	3		68,108,941	86,351,827	101,138,751
	4		89,556,120	131,415,299	152,690,882
	5		18,943,552	34,759,299	43,365,832
	S. Area		246,420,989	366,133,770	424,730,441
NED Alternative	1		58,378,320	80,027,449	107,854,863
	2		75,892,466	90,859,475	113,029,537
	3		77,796,471	92,840,501	111,409,100
	4		113,746,714	143,249,891	186,373,445
	5		27,290,483	38,194,272	52,708,216
	S. Area		353,104,454	445,171,588	571,375,161
Preferred Alternative	1		58,328,981	79,997,198	107,853,465
	2		75,742,369	90,664,488	112,795,478
	3		77,617,412	92,718,681	111,368,690
	4		113,412,704	143,039,049	186,347,718
	5		27,234,043	38,163,483	52,707,348
	S. Area		352,335,509	444,582,899	571,072,699
EQ Alternative	1		58,323,709	79,994,427	107,851,259
	2		72,652,988	88,211,312	110,292,162
	3		77,617,412	92,718,681	111,368,690
	4		113,179,850	142,884,424	186,208,739
	5		27,228,125	38,074,811	52,607,346
	S. Area		349,002,084	441,883,655	568,328,196

SOIL LOSS

Tables 5-2 and 5-3 indicate that soil loss from water erosion would greatly exceed soil loss from wind erosion. All four alternatives would result in a sharp reduction in water erosion when compared to the present and future without project conditions. Three of the alternatives would have a slight increase in wind erosion, with only the EQ alternative reducing wind erosion below the estimated future without project rate. Table 5-4 lists the acres exceeding various soil loss levels. There are about 3 million acres which would exceed tolerable limits under present and future without project conditions. The preferred alternative and the EQ alternative would result in all land being used within tolerable soil loss limits. The NED and OBERS alternatives would still have a small amount exceeding tolerable limits. Again the differences between alternatives will not be as striking as might be expected because in most cases the soil loss would be reduced for the profit motive and not the soil loss constraint. The approximate 49,000 acres that appear with the preferred and EQ alternatives exceeding 5 and 7 tons occur on highly erosive SRG's where there are no practical treatments to control soil loss.

Table 5-2 - ANNUAL SOIL LOSS FROM WATER EROSION (TONS)

Alternatives	County Group	1975	1985	2000	2020
Without Project Conditions	1	6,293,177		6,554,644	
	2	6,509,302		6,377,794	
	3	4,980,294		4,904,186	
	4	7,938,873		7,962,708	
	5	3,730,727		3,651,354	
	S. Area	29,452,373		29,450,686	
Minimum OBERS Alternative	1		2,210,634	2,284,955	2,315,701
	2		2,286,706	2,319,921	2,269,487
	3		1,597,048	1,835,284	1,760,867
	4		3,116,711	3,678,924	3,642,670
	5		1,532,008	1,622,625	1,621,109
	S. Area		10,743,107	11,741,709	11,609,834
NED Alternative	1		2,604,072	2,702,874	2,843,049
	2		3,157,181	3,330,029	3,634,696
	3		2,001,344	2,100,982	2,117,024
	4		3,564,443	3,658,117	3,971,346
	5		1,807,542	1,894,250	2,024,521
	S. Area		13,134,582	13,686,252	14,590,636
Preferred Alternative	1		2,530,324	2,634,099	2,768,141
	2		3,127,773	3,305,615	3,606,174
	3		1,927,910	2,050,472	2,100,720
	4		3,445,719	3,572,964	3,957,313
	5		1,666,344	1,753,332	1,885,236
	S. Area		12,698,070	13,316,482	14,317,584
EQ Alternative	1		2,513,993	2,617,768	2,751,810
	2		2,929,852	3,094,931	3,351,191
	3		1,926,489	2,050,472	2,100,720
	4		3,422,010	3,572,570	3,949,848
	5		1,663,011	1,755,909	1,891,122
	S. Area		12,455,355	13,091,650	14,044,691

Table 5-3 - ANNUAL SOIL LOSS FROM WIND EROSION (TONS)

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	493,805		495,707	
	2	1,708,904		1,714,548	
	3	1,415,104		1,360,694	
	4	1,819,489		1,989,938	
	5	182,277		272,754	
	S. Area	5,619,579		5,833,641	1/
Minimum OBERS Alternative	1		171,322	333,805	452,096
	2		1,221,860	1,534,987	1,685,604
	3		1,593,164	1,954,239	1,821,396
	4		1,436,406	2,639,019	2,695,617
	5		201,716	311,185	282,844
	S. Area		4,624,468	6,773,235	6,937,557
NED Alternative	1		476,023	535,793	745,897
	2		2,183,025	2,460,914	3,080,368
	3		1,759,982	2,095,945	2,159,863
	4		1,838,121	1,832,459	2,474,282
	5		303,747	453,262	662,911
	S. Area		6,560,898	7,378,373	9,123,321
Preferred Alternative	1		475,317	534,067	742,711
	2		2,033,312	2,369,417	2,953,553
	3		1,767,565	2,101,158	2,161,536
	4		1,838,121	1,832,459	2,474,282
	5		315,514	458,229	660,710
	S. Area		6,429,829	7,295,330	8,992,792
EQ Alternative	1		457,189	538,019	746,663
	2		646,314	842,558	1,150,913
	3		1,766,855	2,101,158	2,161,536
	4		1,497,721	1,697,387	2,293,034
	5		277,543	385,621	566,412
	S. Area		4,645,622	5,564,743	6,918,558

1/ Land treatment resulting from ongoing programs will reduce erosion rates; however, the projected increase in cropland acres results in a net increase in tons of erosion. (See Table 5-5, 5-6, and 5-7.)

Table 5-4 - ACRES EXCEEDING SOIL LOSS LEVELS

Amount of Soil Loss	Without Project Conditions		Future Conditions - 1985				Future Conditions - 2000				Future Conditions - 2020			
	1975	2000	NED Alt.	Prefer. Alt.	EQ Alt.	Minimum OBERS Alt.	NED Alt.	Prefer. Alt.	EQ Alt.	Minimum OBERS Alt.	NED Alt.	Prefer. Alt.	EQ Alt.	Minimum OBERS Alt.
1 Ton														
Wind	2103868	2221378	2033976	2039041	1691857	1557049	2602102	2603767	1920528	2601440	2964977	2963058	2524684	2436533
Water	9139463	9160300	2428237	2312196	2298038	1061738	2794337	2696618	2673541	1542132	3265963	3184742	3148465	1276128
Total	11243331	3137408	4462213	4351237	3989895	2618787	5396439	5300385	4594069	4143572	6230940	6147800	5673149	3712661
2 Tons														
Wind	680860	592376	660659	627400	---	444550	623239	607219	---	702169	770995	746375	---	598173
Water	3396120	3408142	196240	64471	49560	62626	167010	62741	49560	68016	125702	62533	49560	64383
Total	4026930	4000518	856899	691871	49560	507176	790249	669960	49560	770185	896997	808908	49560	662556
3 Tons														
Wind	234663	223066	591462	559193	---	331988	494133	479103	---	371700	611733	588103	---	413627
Water	2944171	2907845	116166	52668	49511	50982	106536	50938	49560	50962	94687	50889	49511	50913
Total	3178834	3139911	707628	611861	49511	382970	600669	530041	49560	422662	706420	638992	49511	464540
5 Tons														
Wind	29572	24628	26000	---		1261	4861	---	---	1061	7561	---	---	561
Water	290735	265713	56807	49201	49201	49294	56856	49250	49250	49273	56807	49201	49201	49224
Total	320307	290341	82807	49201	49201	50555	61717	49250	49250	51334	54368	49201	49201	49785
7 Tons														
Wind	11147	7320	3061	---	---	1261	4861	---	---	1061	7561	---	---	561
Water	137818	104147	49662	49201	49201	49294	49711	49250	49250	49250	49662	49201	49201	49201
Total	148965	111467	52723	49201	49201	50555	54572	49250	49250	50311	57223	49201	49201	49762
Tolerable Levels	3071888	2990260	168309	---	---	2344	125150	---	---	7578	95350	---	---	3401

LAND USE CONVERSIONS

Tables 5-5 through 5-8 show that the OBERS alternative would result in less pastureland and rangeland converted to cropland than the other three alternatives. This was because the forage was needed to satisfy the OBERS livestock requirement. The OBERS alternative would result in more cropland converted to rangeland and pastureland for the same reason. (See Tables 5-9 and 5-10) Table 5-11 shows that about 125,000 acres are being irrigated. This is based on the 1967 Conservation Needs Inventory. The model was constrained to allow no more than an additional 267,000 acres to be converted to irrigated land, based on estimates of water available for irrigation. None of the alternatives would approach this amount of irrigation development because of additional constraints that were inadvertently introduced into the model.

Table 5-5 - ACRES OF ADEQUATELY TREATED RANGELAND CONVERTED TO CROPLAND

Alternatives	County Group	Time Periods (Base) 1975 1/	1985	2000	2020
Without Project Conditions	1	1,187,803		13,308	
	2	2,437,727		57,908	
	3	277,474		100	
	4	2,050,313		77,368	
	5	755,647		36,261	
	S. Area	6,708,964		184,945	
Minimum OBERS Alternative	1		13,300	105,562	181,800
	2		---	156,900	168,400
	3		100	11,600	17,500
	4		---	183,600	252,100
	5		---	75,600	134,800
	S. Area		13,400	533,262	754,600
NED Alternative	1		55,200	121,500	221,100
	2		106,700	235,000	427,100
	3		5,600	12,900	23,300
	4		109,900	242,300	443,200
	5		42,900	105,600	192,200
	S. Area		320,300	717,300	1,306,900
Preferred Alternative	1		55,200	121,500	221,100
	2		106,700	235,000	427,100
	3		5,600	12,900	23,300
	4		109,900	242,300	443,200
	5		42,900	105,600	192,200
	S. Area		320,300	717,300	1,306,900
EQ Alternative	1		55,200	121,500	221,100
	2		106,700	235,000	427,100
	3		5,600	12,900	23,300
	4		109,900	242,300	443,200
	5		42,900	105,600	192,200
	S. Area		320,300	717,300	1,306,900

1/ Base - 1975 - Data reflect acres converted to cropland compared to total acres of adequately treated rangeland in 1975.

Table 5-6 - ACRES OF INADEQUATELY TREATED RANGELAND CONVERTED TO CROPLAND

Alternatives	County Group	Time Periods (Base) 1975 1/	1985	2000	2020
Without Project Conditions	1	3,568,720		63,994	
	2	1,577,675		102,046	
	3	773,185		510	
	4	2,353,458		184,322	
	5	1,619,482		88,541	
	S. Area	9,892,520		439,413	
Minimum OBERS Alternative	1		101,800	298,600	516,100
	2		13,060	131,600	149,420
	3		16,500	90,300	136,100
	4		30,426	311,300	414,800
	5		---	144,100	232,300
	S. Area		161,786	975,900	1,448,720
NED Alternative	1		169,500	372,900	677,800
	2		84,000	184,200	336,900
	3		47,700	105,100	191,200
	4		189,200	415,900	759,800
	5		101,900	233,300	424,100
	S. Area		592,300	1,311,400	2,389,800
Preferred Alternative	1		169,500	372,900	677,800
	2		84,000	184,200	336,900
	3		47,700	105,100	191,200
	4		189,200	415,900	759,800
	5		101,900	233,300	424,100
	S. Area		592,300	1,311,400	2,389,800
EQ Alternative	1		169,500	372,900	677,800
	2		84,000	184,200	336,900
	3		47,700	105,100	191,200
	4		189,200	415,900	759,800
	5		101,900	233,300	424,100
	S. Area		592,300	1,311,400	2,389,800

1/ Base - 1975 - Data reflect acres converted to cropland compared to total acres of inadequately treated rangeland in 1975.

Table 5-7 - ACRES OF RANGELAND NEEDING RESEEDING CONVERTED TO CROPLAND

Alternatives	County Group	Time Periods (Base) 1975 1/	1985	2000	2020
Without Project Conditions	1	10,446		2,398	
	2	---		---	
	3	21,843		1,691	
	4	104,125		27,820	
	5	38,086		4,899	
	S. Area	174,500		36,808	
Minimum OBERS Alternative	1		400	8,535	1,700
	2		---	---	---
	3		3,400	9,000	16,300
	4		800	25,000	43,800
	5		---	4,200	3,600
	S. Area		4,600	46,735	65,400
NED Alternative	1		1,100	8,335	4,600
	2		---	---	---
	3		4,100	9,000	16,300
	4		13,900	30,700	55,900
	5		2,100	4,400	7,900
	S. Area		21,200	52,435	84,700
Preferred Alternative	1		1,100	8,335	4,600
	2		---	---	---
	3		4,100	9,000	16,300
	4		13,900	30,700	55,900
	5		2,100	4,400	7,900
	S. Area		21,200	52,435	84,700
EQ Alternative	1		1,100	8,335	4,600
	2		---	---	---
	3		4,100	9,000	16,300
	4		13,900	30,700	55,900
	5		2,100	4,400	7,900
	S. Area		21,200	52,435	84,700

1/ Base - 1975 - Data reflect acres converted to cropland compared with total acres of rangeland needing reseeding in 1975.

Table 5-8 - ACRES OF PASTURELAND CONVERTED TO CROPLAND

Alternatives	County Group	(Base) 1975 1/	Time Periods 1985	2000	2020
Without Project Conditions	1	102,236		5,369	
	2	40,402		1,440	
	3	71,334		25,830	
	4	109,602		9,310	
	5	38,498		470	
	S. Area	362,072		42,419	
Minimum OBERS Alternative	1			900	
	2			---	
	3			---	
	4			---	
	5			---	
	S. Area			900	
NED Alternative	1		9,300	19,800	35,900
	2		---	---	---
	3		9,000	25,100	45,600
	4		11,000	24,400	44,800
	5		400	2,800	5,700
	S. Area		29,700	72,100	132,000
Preferred Alternative	1		9,300	19,800	35,900
	2		---	---	---
	3		9,000	25,100	45,600
	4		11,000	24,400	44,800
	5		400	2,800	5,700
	S. Area		29,700	72,100	132,000
EQ Alternative	1		9,300	19,800	35,900
	2		---	---	---
	3		9,000	25,100	45,600
	4		11,000	24,400	44,800
	5		400	2,800	5,700
	S. Area		29,700	72,100	132,000

1/ Base - 1975 - Data reflect acres converted to cropland compared with total acres of pastureland in 1975.

Table 5-9 - ACRES OF CROPLAND CONVERTED TO RANGELAND

Alternatives	County Group	Time Periods (Base) 1975 1/	1985	2000	2020
Without Project Conditions	1	594,776		400	
	2	1,157,601		17,390	
	3	1,349,353		13,199	
	4	1,502,074		21,430	
	5	294,253		7,880	
	S. Area	4,898,057		60,299	
Minimum OBERS Alternative	1		42,476	46,300	94,876
	2		128,705	105,345	221,445
	3		128,360	87,260	135,530
	4		143,836	130,636	252,736
	5		56,100	51,900	106,437
	S. Area		499,477	421,441	811,024
NED Alternative	1		2,800	6,300	11,400
	2		13,403	10,463	11,863
	3		39,600	55,900	53,300
	4		40,178	63,778	100,078
	5		1,000	5,600	3,160
	S. Area		96,981	142,041	179,801
Preferred Alternative	1		15,792	21,592	29,992
	2		13,403	10,463	11,863
	3		39,600	55,900	53,300
	4		40,639	64,239	100,539
	5		29,400	36,400	36,044
	S. Area		138,834	188,594	231,738
EQ Alternative	1		15,792	21,592	29,992
	2		13,403	10,463	11,863
	3		39,600	55,900	53,300
	4		40,639	64,239	100,539
	5		29,400	36,400	36,044
	S. Area		138,834	188,594	231,738

1/ Base - 1975 - Data reflect acres converted to rangeland compared with total acres of cropland in 1975.

Table 5-10 - ACRES OF CROPLAND CONVERTED TO PASTURELAND

Alternatives	County Group	Time Periods (Base) 1975 1/	1985	2000	2020
Without Project Conditions	1	594,776		17,970	
	2	1,157,601		72,290	
	3	1,349,353		4,630	
	4	1,502,074		24,610	
	5	294,253		27,470	
	S. Area	4,898,057		146,970	
Minimum OBERS Alternative	1		20,000	43,900	82,000
	2		32,000	70,000	128,600
	3		2,700	5,900	10,800
	4		22,600	49,800	90,400
	5		15,900	35,000	63,600
	S. Area		93,200	205,300	375,400
NED Alternative	1		3,600	8,200	15,000
	2		8,500	18,700	33,400
	3		500	1,200	2,200
	4		4,800	10,500	18,700
	5		3,300	4,100	7,400
	S. Area		20,700	42,700	76,700
Preferred Alternative	1		3,600	8,200	15,000
	2		8,500	18,700	33,400
	3		500	1,200	2,200
	4		4,800	10,500	18,700
	5		3,300	4,100	7,400
	S. Area		20,700	42,700	76,700
EQ Alternative	1		3,600	8,200	15,000
	2		8,500	18,700	33,400
	3		500	1,200	2,200
	4		4,800	10,500	18,700
	5		3,300	4,100	7,400
	S. Area		20,700	42,700	76,700

1/ Base - 1975 - Data reflect acres converted to pastureland compared with total acres of cropland in 1975.

Table 5-11 - ACRES OF DRYLAND CROPLAND CONVERTED TO IRRIGATED CROPLAND

Alternatives	County Group	(Irrigated) (Base) 1975 1/	Time Periods 1985	2000	2020
Without Project Conditions	1	69,259		4,000	
	2	4,649		9,300	
	3	5,055		13,001	
	4	14,550		9,000	
	5	31,931		5,100	
	S. Area	125,444		40,401	
Minimum 2/ OBERS Alternative	1		---	---	1,830
	2		---	---	1,105
	3		8,640	22,780	36,970
	4		1,370	2,410	2,755
	5		---	3,230	3,690
	S. Area		10,010	28,420	46,350
NED 2/ Alternative	1		---	---	1,830
	2		---	---	1,105
	3		1,340	22,780	36,970
	4		1,370	2,410	2,755
	5		---	3,230	3,690
	S. Area		2,710	28,420	46,350
Preferred 2/ Alternative	1		---	---	1,830
	2		---	---	1,105
	3		1,340	22,780	36,970
	4		1,370	2,410	2,755
	5		---	3,230	3,690
	S. Area		2,710	28,420	46,350
EQ 2/ Alternative	1		---	---	1,830
	2		---	---	1,105
	3		1,340	22,780	36,970
	4		1,370	2,410	2,755
	5		---	3,230	3,690
	S. Area		2,710	28,420	46,350

1/ Data reflect acres of cropland (dryland) converted to irrigation compared with total acres under irrigation in 1975.

2/ The figures for these alternatives do not reflect the full development potential. (See page 5-11.)

LAND USE ACREAGES

Table 5-12 shows that an increase in cropland of about one-half million acres is expected under future without project conditions by 2000. All the alternatives would result in a greater increase in cropland than was predicted with the future without project conditions. Tables 5-13 and 5-14 show a decrease in pasture and range. The goal of maximizing net revenue has the greatest impact on these shifts in land use. Again the OBERS alternative would result in more pasture and range than the other three alternatives because of the livestock forage requirement. Because of the constraints used in evaluating impacts on private non-commercial forest land, acreage levels remain the same for future time periods (table 5-15).

Table 5-12 - CROPLAND ACREAGE

Alternatives	County Group	1975	1985	2000	2020
		Time Periods			
Without Project Conditions	1	664,037		730,736	
	2	1,162,250		1,233,964	
	3	1,354,407		1,364,709	
	4	1,516,624		1,769,404	
	5	326,184		421,005	
	S. Area	5,023,502		5,519,818	
Minimum OBERS Alternative	1		717,059	987,432	1,186,759
	2		1,014,605	1,274,705	1,130,025
	3		1,243,348	1,372,148	1,377,978
	4		1,381,414	1,856,088	1,884,188
	5		254,184	463,184	526,847
	S. Area		4,610,610	5,953,557	6,105,797
NED Alternative	1		892,735	1,172,070	1,577,035
	2		1,331,047	1,552,287	1,880,987
	3		1,380,708	1,449,408	1,575,308
	4		1,795,646	2,155,646	2,701,546
	5		469,184	662,584	945,524
	S. Area		5,869,320	6,991,995	8,680,400
Preferred Alternative	1		879,743	1,156,778	1,558,443
	2		1,331,047	1,552,287	1,880,987
	3		1,380,708	1,449,408	1,575,308
	4		1,795,185	2,155,185	2,701,085
	5		440,784	631,784	912,640
	S. Area		5,827,467	6,945,442	8,628,463
EQ Alternative	1		879,743	1,156,778	1,558,443
	2		1,331,047	1,552,287	1,880,987
	3		1,380,708	1,449,408	1,575,308
	4		1,795,185	2,155,185	2,701,085
	5		440,784	631,784	912,640
	S. Area		5,827,467	6,945,442	8,628,463

Table 5-13 - PASTURELAND ACREAGE

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	102,236		114,837	
	2	40,402		111,252	
	3	71,334		50,134	
	4	109,602		124,902	
	5	38,498		65,498	
	S. Area	362,072		466,623	
Minimum OBERS Alternative	1		122,236	145,236	184,236
	2		72,402	111,102	169,002
	3		74,034	77,234	82,134
	4		132,202	159,402	200,002
	5		54,398	73,498	102,098
	S. Area		455,272	566,472	737,472
NED Alternative	1		96,536	90,636	81,336
	2		48,902	59,102	73,802
	3		62,834	47,434	27,934
	4		103,402	95,702	83,502
	5		41,398	39,798	40,198
	S. Area		353,072	332,672	306,772
Preferred Alternative	1		95,536	90,623	81,336
	2		48,902	59,102	73,802
	3		62,834	47,434	27,934
	4		103,402	95,702	83,502
	5		41,398	39,798	40,198
	S. Area		353,072	332,672	306,772
EQ Alternative	1		96,536	90,636	81,336
	2		48,902	59,102	73,802
	3		62,834	47,434	27,934
	4		103,402	95,702	83,502
	5		41,398	39,798	40,198
	S. Area		353,072	332,672	306,772

Table 5-14 - RANGELAND ACREAGE

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	4,766,969		4,687,669	
	2	4,015,402		3,872,838	
	3	1,072,502		1,083,400	
	4	4,507,896		4,239,816	
	5	2,413,215		2,291,394	
	S. Area	16,775,984		16,175,117	
Minimum OBERS Alternative	1		4,693,947	4,400,574	4,162,247
	2		4,131,074	3,832,247	3,919,027
	3		1,180,861	1,048,861	1,038,131
	4		4,620,506	4,118,632	4,049,932
	5		2,469,315	2,241,215	2,148,952
	S. Area		17,095,676	15,641,529	15,318,289
NED Alternative	1		4,543,971	4,270,536	3,874,871
	2		3,838,105	3,606,665	3,263,265
	3		1,054,701	1,001,401	895,001
	4		4,235,074	3,882,774	3,349,074
	5		2,267,315	2,075,515	1,792,175
	S. Area		15,939,166	14,836,891	13,174,386
Preferred Alternative	1		4,556,963	4,285,828	3,893,463
	2		3,838,105	3,606,665	3,263,265
	3		1,054,701	1,001,401	895,001
	4		4,235,535	3,883,235	3,349,535
	5		2,295,715	2,106,315	1,825,059
	S. Area		15,981,019	14,883,444	13,226,323
EQ Alternative	1		4,556,963	4,285,828	3,893,463
	2		3,838,105	3,606,665	3,263,265
	3		1,054,701	1,001,401	895,001
	4		4,235,535	3,883,235	3,349,535
	5		2,295,715	2,106,315	1,825,059
	S. Area		15,981,019	14,883,444	13,226,323

Table 5-15 - PRIVATE NON-COMMERCIAL FOREST LAND ACREAGE

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	138,784		138,784	
	2	26,707		26,707	
	3	20,698		20,698	
	4	74,631		74,631	
	5	278,893		278,893	
	S. Area	539,712		539,712	
Minimum OBERS Alternative	1		138,782	138,782	138,782
	2		26,707	26,707	26,707
	3		20,699	20,699	20,699
	4		74,631	74,631	74,631
	5		278,893	278,893	278,893
	S. Area		539,712	539,712	539,712
NED Alternative	1		138,782	138,782	138,782
	2		26,707	26,707	26,707
	3		20,699	20,699	20,699
	4		74,631	74,631	74,631
	5		278,893	278,893	278,893
	S. Area		539,712	539,712	539,712
Preferred Alternative	1		138,782	138,782	138,782
	2		26,707	26,707	26,707
	3		20,699	20,699	20,699
	4		74,631	74,631	74,631
	5		278,893	278,893	278,893
	S. Area		539,712	539,712	539,712
EQ Alternative	1		138,782	138,782	138,782
	2		26,707	26,707	26,707
	3		20,699	20,699	20,699
	4		74,631	74,631	74,631
	5		278,893	278,893	278,893
	S. Area		539,712	539,712	539,712

PRODUCTION BY COMMODITIES

As a result of improved management and changes in land use patterns, production of most crops would increase for the land use alternatives evaluated in the study. Corn production would increase 40 to 90 percent for all alternatives, except for minimum OBERS (table 5-16). Corn cut for silage would increase even more sharply from a minimum of 90 percent to nearly a 400 percent increase for the NED alternative (table 5-17). Because soil loss potential is increased when corn is cut for silage, the EQ alternative would have the smallest increase in production.

In contrast to other row crops, grain sorghum would have its greatest output under minimum OBERS (table 5-18). Sorghum production would increase nearly 700 percent by 2020 to meet minimum OBERS requirements. However, sorghum silage would not be produced under future conditions, except for minimum OBERS demands (table 5-19).

Small grain production would increase rather sharply for the various alternatives evaluated. For example, wheat would increase nearly five times by 2020 for the EQ alternative (table 5-20). The NED alternative shows oats production doubling (table 5-21). Wheat seems to be one of the more desirable crops for both environmental quality and net revenue because it is one of the few crops where the EQ alternative would result in the largest increase in output.

The remaining crops evaluated, alfalfa, other hay, and range production generally are less vulnerable to erosion than row crops and small grain. Alfalfa would show its greatest production increase under the EQ alternative where soil loss constraints are the most severe. See table 5-22. As indicated in table 5-23, other hay production would decrease sharply because of its economic disadvantage compared with other crops. Range and pasture production would show its greatest increase to meet minimum OBERS requirements, but trends toward decreased output by 2020 (table 5-24). This decline is due to decreased acreage previously shown.

Table 5-16 - CORN FOR GRAIN (BU)

Alternatives	County Group	1975	1985	2000	2020
Without Project Conditions	1	992,662		1,130,173	
	2	971,490		1,368,522	
	3	2,303,079		3,080,412	
	4	1,693,403		2,436,982	
	5	352,473		543,172	
	S. Area	6,313,107		8,559,261	
Minimum OBERS Alternative	1		455,912	1,491,867	1,759,849
	2		89,084	162,827	339,041
	3		4,380,278	4,332,698	5,185,040
	4		802,750	934,429	1,042,508
	5		1,423,334	1,716,979	1,900,187
	S. Area		7,151,358	8,638,800	10,226,625
NED Alternative	1		1,633,480	1,619,545	1,942,860
	2		385,766	762,665	1,185,531
	3		4,645,049	5,015,307	5,782,500
	4		802,750	934,429	1,403,326
	5		1,430,139	1,724,165	1,901,182
	S. Area		8,897,184	10,056,111	12,215,399
Preferred Alternative	1		1,633,480	1,619,545	1,942,860
	2		429,346	698,979	1,121,040
	3		4,667,799	5,032,685	5,788,635
	4		802,750	934,429	1,403,326
	5		1,429,070	1,723,114	1,900,187
	S. Area		8,962,445	10,008,752	12,156,048
EQ Alternative	1		1,620,168	1,605,588	1,927,899
	2		548,908	820,909	1,316,295
	3		4,667,799	5,032,685	5,788,635
	4		800,980	931,961	1,401,391
	5		1,429,070	1,723,114	1,900,187
	S. Area		9,066,925	10,114,257	12,334,407

Table 5-17 - CORN FOR SILAGE (TON)

Alternatives	County Group	1975	1985	2000	2020
Without Project Conditions	1	119,922		136,257	
	2	393,882		495,113	
	3	207,661		265,539	
	4	411,543		563,252	
	5	37,060		76,809	
	S. Area	1,170,068		1,536,970	
Minimum OBERS Alternative	1		91,948	266,461	312,493
	2		1,207,349	1,575,297	1,890,392
	3		462,995	514,910	422,539
	4		398,428	594,388	594,033
	5		304,624	373,063	409,519
	S. Area		2,465,344	3,324,119	3,628,976
NED Alternative	1		307,494	307,707	373,520
	2		2,092,102	2,435,852	3,139,143
	3		556,128	627,879	732,040
	4		713,448	811,389	1,101,009
	5		307,115	389,398	467,111
	S. Area		3,976,287	4,572,225	5,812,823
Preferred Alternative	1		307,494	307,707	373,520
	2		1,970,119	2,350,958	3,003,145
	3		556,128	627,879	732,040
	4		713,448	811,389	1,101,009
	5		306,995	388,901	466,219
	S. Area		3,854,184	4,486,834	5,675,933
EQ Alternative	1		305,081	305,174	370,796
	2		597,124	786,900	1,085,189
	3		556,128	627,879	732,040
	4		444,840	719,364	952,078
	5		306,995	387,367	466,219
	S. Area		2,210,168	2,826,684	3,606,322

Table 5-18 - SORGHUM FOR GRAIN (BU)

Alternatives	County Group	1975	1985	2000	2020
Without Project Conditions	1	---		---	
	2	---		---	
	3	2,098,954		2,290,204	
	4	228,711		289,163	
	5	---		---	
	S. Area	2,327,665		2,579,367	
Minimum OBERS Alternative	1		---	---	---
	2		---	---	---
	3		1,763,612	4,026,971	4,748,206
	4		5,442,287	9,220,827	13,847,591
	5		---	---	---
	S. Area		7,205,899	13,247,798	18,595,797
NED Alternative	1		---	---	---
	2		---	---	---
	3		972,640	3,481,791	4,207,427
	4		5,159,062	6,104,276	7,590,816
	5		---	---	---
	S. Area		6,131,702	9,586,067	11,798,243
Preferred Alternative	1		---	---	---
	2		---	---	---
	3		972,640	3,481,791	4,207,427
	4		5,159,062	6,104,276	7,590,816
	5		---	---	---
	S. Area		6,131,702	9,586,067	11,798,243
EQ Alternative	1		---	---	---
	2		---	---	---
	3		972,640	3,481,791	4,207,427
	4		5,159,062	6,104,276	7,590,816
	5		---	---	---
	S. Area		6,131,702	9,586,067	11,798,243

Table 5-19 - SORGHUM FOR SILAGE (TON)

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	---		---	
	2	---		---	
	3	---		---	
	4	25,095		32,577	
	5	---		---	
	S. Area	25,095		32,577	
Minimum OBERS Alternative	1		---	---	---
	2		---	---	---
	3		---	---	---
	4		216,199	397,400	556,900
	5		---	---	---
	S. Area		216,199	397,400	556,900
NED Alternative	1				
	2				
	3				
	4				
	5				
	S. Area				
Preferred Alternative	1				
	2				
	3				
	4				
	5				
	S. Area				
EQ Alternative	1				
	2				
	3				
	4				
	5				
	S. Area				

Table 5-20 - WHEAT (BU)

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	2,416,172		3,012,433	
	2	6,402,695		7,430,925	
	3	4,191,499		4,690,243	
	4	10,222,453		12,788,017	
	5	694,454		1,037,652	
	S. Area	23,927,273		28,959,270	
Minimum OBERS Alternative	1		4,222,848	12,088,246	14,203,487
	2		1,008,406	1,139,458	478,336
	3		4,707,189	7,208,987	7,808,816
	4		16,072,811	23,505,769	26,630,186
	5		2,174,398	5,972,915	8,481,884
	S. Area		28,185,652	49,915,375	57,602,709
NED Alternative	1		12,188,709	17,556,856	25,802,335
	2		8,396,536	10,340,237	13,540,504
	3		7,680,353	7,654,197	8,992,682
	4		24,416,226	29,832,347	40,938,192
	5		4,775,115	7,438,135	11,807,389
	S. Area		57,456,939	72,821,772	101,081,102
Preferred Alternative	1		12,192,198	17,558,945	25,802,442
	2		8,481,023	10,352,332	13,557,940
	3		7,680,353	7,654,197	8,992,682
	4		24,416,226	29,832,347	40,938,192
	5		4,775,115	7,438,135	11,807,389
	S. Area		57,544,915	72,835,956	101,098,645
EQ Alternative	1		12,192,198	17,558,945	25,802,442
	2		14,819,851	18,073,135	23,157,538
	3		7,679,784	7,654,197	8,992,682
	4		24,416,226	29,832,347	40,938,192
	5		4,775,115	7,438,135	11,807,389
	S. Area		63,883,174	80,556,759	110,698,243

Table 5-21 - OATS (BU)

Alternatives	County Group	1975	1985	2000	2020
Without Project Conditions	1	3,068,272		3,769,928	
	2	3,265,606		4,134,831	
	3	5,087,377		5,635,894	
	4	4,383,377		5,832,532	
	5	711,321		1,121,265	
	S. Area	16,515,953		20,494,450	
Minimum OBERS Alternative	1		693,918	465,670	498,186
	2		8,715,219	11,691,516	13,915,553
	3		7,540,042	8,155,235	8,807,072
	4		2,912,326	5,136,405	5,990,834
	5		296,595	435,362	352,831
	S. Area		20,158,100	25,884,188	29,564,476
NED Alternative	1		1,268,960	1,877,840	2,666,636
	2		14,959,531	18,063,347	23,387,054
	3		8,205,164	9,425,354	11,033,433
	4		2,891,073	3,117,290	4,734,220
	5		338,848	530,060	838,874
	S. Area		27,663,576	33,013,891	42,660,217
Preferred Alternative	1		1,278,032	1,883,272	2,666,886
	2		14,331,498	17,646,207	22,691,796
	3		8,238,025	9,447,945	11,041,242
	4		2,891,073	3,117,290	4,734,220
	5		351,575	537,054	839,841
	S. Area		27,090,203	32,631,768	41,973,985
EQ Alternative	1		1,281,951	1,887,406	2,671,331
	2		4,526,931	6,026,275	8,412,547
	3		8,238,025	9,447,945	11,041,242
	4		1,524,354	2,785,269	4,180,307
	5		351,575	535,520	839,841
	S. Area		15,922,836	20,682,415	27,145,268

Table 5-22 - ALFALFA (TON)

Alternatives	County Group	1975	1985	2000	2020
Without Project Conditions	1	337,606		406,571	
	2	326,938		412,230	
	3	424,761		511,300	
	4	302,863		420,316	
	5	88,769		138,377	
	S. Area	1,480,937		1,888,794	
Minimum OBERS Alternative	1		144,773	96,415	101,549
	2		20,134	34,469	11,149
	3		872,020	975,647	1,243,111
	4		178,316	316,272	298,740
	5		51,541	88,080	95,535
	S. Area		1,266,784	1,510,883	1,750,084
NED Alternative	1		179,793	254,169	341,453
	2		48,114	115,665	187,277
	3		888,780	1,092,455	1,368,307
	4		119,998	388,983	530,472
	5		63,066	103,887	163,867
	S. Area		1,299,751	1,955,159	2,591,376
Preferred Alternative	1		181,886	255,422	341,506
	2		86,457	146,812	238,322
	3		896,363	1,097,668	1,369,980
	4		119,998	388,983	530,472
	5		65,300	105,110	164,025
	S. Area		1,350,004	1,993,995	2,644,305
EQ Alternative	1		182,698	256,258	342,414
	2		90,203	140,924	229,247
	3		896,363	1,097,668	1,369,980
	4		222,429	421,220	584,752
	5		65,300	103,576	161,441
	S. Area		1,456,993	2,019,646	2,687,834

Table 5-23 - OTHER HAY (TON)

Alternatives	County Group	1975	1985	2000	2020
Without Project Conditions	1	60,463		71,032	
	2	45,347		55,656	
	3	90,762		111,950	
	4	84,719		137,482	
	5	16,837		27,023	
	S. Area	298,128		403,143	
Minimum OBERS Alternative	1		253,951	222,765	384,333
	2		277,711	459,002	442,386
	3		69,356	68,349	59,419
	4		36,765	15,262	1,962
	5		6,095	2,609	1,389
	S. Area		643,878	767,987	889,489
NED Alternative	1			---	
	2			---	
	3			---	
	4			4	
	5			---	
	S. Area			4	
Preferred Alternative	1		2	2	2
	2		---	---	---
	3		2	2	2
	4		9,166	5,786	706
	5		9	13	9
	S. Area		9,179	5,803	719
EQ Alternative	1		2	2	2
	2		---	---	---
	3		2	2	2
	4		9,166	5,786	706
	5		9	13	9
	S. Area		9,179	5,803	719

Table 5-24 - RANGELAND, PASTURELAND AND NON-COMMERCIAL FORESTLAND (AUM)

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	1,395,792		1,362,327	
	2	1,519,479		1,692,282	
	3	508,677		475,282	
	4	1,890,620		1,901,922	
	5	881,591		878,415	
	S. Area	6,196,159		6,310,228	
Minimum OBERS Alternative	1		2,343,846	2,491,356	2,353,782
	2		2,666,771	2,653,019	2,741,535
	3		873,845	886,783	852,793
	4		3,316,656	3,215,769	3,142,532
	5		1,498,800	1,529,157	1,464,902
	S. Area		10,699,918	10,776,084	10,555,544
NED Alternative	1		2,089,184	2,288,090	1,988,394
	2		2,401,433	2,421,220	2,155,041
	3		786,999	779,890	645,236
	4		2,928,656	2,894,660	2,415,652
	5		1,310,914	1,371,399	1,171,055
	S. Area		9,517,186	9,755,259	8,375,378
Preferred Alternative	1		2,089,184	2,288,090	1,988,394
	2		2,401,433	2,421,220	2,155,041
	3		786,999	779,890	645,236
	4		2,928,656	2,894,660	2,415,652
	5		1,310,914	1,371,399	1,171,055
	S. Area		9,517,186	9,755,259	8,375,378
EQ Alternative	1		2,089,184	2,288,090	1,988,394
	2		2,401,433	2,421,220	2,155,041
	3		786,999	779,890	645,236
	4		2,928,656	2,894,660	2,415,652
	5		1,310,914	1,371,399	1,171,055
	S. Area		9,517,186	9,755,259	8,375,378

CROPLAND TREATMENT

One of the major innovations likely to take place in farming during the next several decades is the increase in use of conservation tillage which can be a major factor in reducing soil losses. As table 5-25 indicates, there was a sharp decrease in cropland farmed utilizing conventional tillage methods. In contrast, the results suggest that conservation tillage would increase one-to-three fold over the next few years (table 5-26). The data suggest that conservation tillage is an important factor in keeping soil losses within specified limits while helping to increase net revenue. To maximize net returns while reducing soil loss to tolerable levels, selected land treatment practices would need to be installed. Contour farming of cropland would increase nearly three times by 2000 and would gradually decline as less costly conservation tillage methods increase (table 5-27).

There would be a sharp increase in windstrips or windbreaks to maintain soil losses within tolerable limits (table 5-28). Windstrips and windbreaks would more than double present levels by 2020. The sharpest increase would be for the EQ alternative where soil loss constraints were the greatest. County groups 1 and 4 would have the largest number of acres requiring such treatment.

Cropland treatment by contour stripcropping would also increase sharply, especially in certain county groupings (table 5-29). Contour stripcropping shows a sharp increase in county groupings 3 and 4 while in groups 1 and 5 it is eliminated in future time frames.

Two other alternative cropland conditions, permanent hay and idle, will not be displayed as treatment alternatives. These alternatives are generally not considered a normal part of a planned cropland tillage program. Also, total rangeland acreage will not add to correct amount with deletion of these two "treatment" alternatives.

Terracing of cropland would increase sharply throughout future time periods (table 5-30). Again county groups 1 and 5 show the largest increase in acres requiring terracing.

As a result of these increased land treatment activities, there would be a noticeable reduction in cropland receiving no treatment as shown in table 5-31. The largest decrease in cropland receiving no treatment was for county groups 3 and 4.

In summary, land treatment is an integral part of an efficient management strategy which results in maximum returns. Land treatment practices on cropland were dominated by conservation tillage, windstrips, windbreaks, and terracing. These treatment alternatives would play a dominant role in reducing soil losses to tolerable levels.

Table 5-25 - CONVENTIONAL CROPLAND TILLAGE (AC.)

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	272,776		229,414	
	2	486,523		433,568	
	3	410,794		357,630	
	4	607,135		527,970	
	5	84,036		95,305	
	S. Area	1,861,264		1,643,887	
Minimum OBERS Alternative	1		---	---	---
	2		---	---	---
	3		195,999	240,799	222,199
	4		---	257,479	---
	5		---	---	---
	S. Area		195,999	498,278	222,199
NED Alternative	1		---	---	---
	2		---	---	---
	3		387,027	302,721	261,999
	4		---	---	328,479
	5		---	---	---
	S. Area		387,027	302,721	590,478
Preferred Alternative	1		---	---	---
	2		---	---	---
	3		387,027	302,721	261,999
	4		---	---	328,479
	5		---	---	---
	S. Area		387,027	302,721	590,478
EQ Alternative	1		---	---	---
	2		---	---	---
	3		385,606	302,721	261,999
	4		---	199	328,479
	5		---	---	---
	S. Area		385,606	302,920	590,478

Table 5-26 - CONSERVATION CROPLAND TILLAGE (AC.)

Alternatives	County Group	1975	1985	2000	2020
Without Project Conditions	1	246,322		342,753	
	2	521,658		642,041	
	3	491,545		559,156	
	4	522,890		783,164	
	5	68,693		128,904	
	S. Area	1,851,108		2,456,018	
Minimum OBERS Alternative	1		268,988	601,738	676,814
	2		385,430	473,430	457,735
	3		889,896	1,005,317	1,083,613
	4		1,201,660	1,507,463	1,872,742
	5		219,784	444,662	522,146
	S. Area		2,965,758	4,032,610	4,613,050
NED Alternative	1		795,678	1,083,113	1,499,978
	2		1,151,977	1,384,217	1,729,417
	3		917,077	1,087,083	1,285,215
	4		1,684,523	2,074,223	2,336,344
	5		418,242	618,542	902,342
	S. Area		4,967,497	6,247,178	7,753,296
Preferred Alternative	1		802,657	1,087,292	1,500,157
	2		1,154,929	1,385,969	1,729,469
	3		942,355	1,104,461	1,290,793
	4		1,684,523	2,074,223	2,336,344
	5		425,226	622,126	902,342
	S. Area		5,009,690	6,274,071	7,759,105
EQ Alternative	1		802,657	1,087,292	1,500,157
	2		1,154,929	1,385,969	1,729,469
	3		943,776	1,104,461	1,290,793
	4		1,684,523	2,074,223	2,336,344
	5		425,226	622,126	902,342
	S. Area		5,011,111	6,273,872	7,759,105

Table 5-27 - CROPLAND TREATED WITH CONTOURING (AC.)

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	6,250		5,688	
	2	---		---	
	3	8,749		17,439	
	4	34,693		43,266	
	5	7,358		12,227	
	S. Area	57,050		78,620	
Minimum OBERS Alternative	1		---	---	69,331
	2		---	---	---
	3		83,742	106,242	---
	4		58,026	14,137	24,523
	5		---	---	---
	S. Area		141,768	120,379	93,854
NED Alternative	1		---	---	---
	2		---	---	---
	3		---	106,842	870
	4		29,237	---	106,123
	5		---	---	---
	S. Area		29,237	106,842	106,993
Preferred Alternative	1		---	---	---
	2		---	---	---
	3		---	106,842	870
	4		29,237	---	106,123
	5		---	---	---
	S. Area		29,237	106,842	106,993
EQ Alternative	1		---	---	---
	2		---	---	---
	3		---	106,842	870
	4		29,237	199	106,123
	5		---	1,867	1,867
	S. Area		29,237	108,908	108,860

Table 5-28 - CROPLAND TREATED WITH WINDSTRIPS OR WINDBREAKS (AC.)

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	72,475		80,342	
	2	169,048		173,449	
	3	225,642		230,063	
	4	96,469		112,772	
	5	51,523		81,790	
	S. Area	615,157		678,416	
Minimum OBERS Alternative	1		31,917	219,452	139,310
	2		4,457	15,057	91,437
	3		144,621	169,121	180,421
	4		507,760	635,700	741,245
	5		67,873	200,103	304,610
	S. Area		756,628	1,239,433	1,457,023
NED Alternative	1		290,347	374,167	478,967
	2		128,623	154,324	194,939
	3		218,743	239,143	265,143
	4		574,360	661,400	791,745
	5		139,615	205,503	314,103
	S. Area		1,351,688	1,634,537	2,044,897
Preferred Alternative	1		290,347	374,167	478,967
	2		128,623	154,324	194,939
	3		218,743	239,143	265,143
	4		574,360	661,400	791,745
	5		140,512	206,400	315,000
	S. Area		1,352,585	1,635,434	2,045,794
EQ Alternative	1		295,489	364,589	469,389
	2		127,448	155,148	196,648
	3		218,743	239,143	265,143
	4		633,088	728,228	870,473
	5		161,556	245,086	364,516
	S. Area		1,436,324	1,732,194	2,166,169

Table 5-29 - CROPLAND TREATED BY CONTOUR STRIPCROPPING (AC.)

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	3,626		3,324	
	2	6,539		5,869	
	3	3,693		3,928	
	4	4,550		5,595	
	5	2,213		3,769	
	S. Area	20,621		22,485	
Minimum OBERS Alternative	1		---	---	---
	2		11,725	40,890	4,386
	3		27,746	---	134,594
	4		199	39,629	184,562
	5		30,542	28,068	---
	S. Area		70,212	108,587	323,542
NED Alternative	1		21,748	239	140,413
	2		27,493	70,393	11,166
	3		32,646	879	248,002
	4		93,380	92,266	292,262
	5		22,657	33,027	---
	S. Area		197,924	200,795	691,843
Preferred Alternative	1		21,748	239	140,413
	2		25,667	73,428	1,779
	3		32,646	870	248,002
	4		93,380	96,266	292,262
	5		22,657	33,027	---
	S. Area		196,098	203,830	682,456
EQ Alternative	1		31,087	9,578	149,752
	2		85,408	96,965	97,540
	3		32,646	870	248,002
	4		1,427	39,615	223,760
	5		24,365	32,868	---
	S. Area		174,933	179,896	719,054

Table 5-30 - CROPLAND TREATED BY TERRACING (AC.)

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	7,828		9,143	
	2	15,696		19,490	
	3	4,400		4,480	
	4	16,624		21,025	
	5	4,006		9,287	
	S. Area	48,544		63,425	
Minimum OBERS Alternative	1		273,330	565,933	590,748
	2		379,873	989,086	457,537
	3		884,112	978,806	960,260
	4		703,237	1,112,510	916,746
	5		108,224	190,945	185,646
	S. Area		2,348,776	3,837,280	3,110,937
NED Alternative	1		424,141	663,985	835,876
	2		995,037	1,158,676	1,521,383
	3		1,046,320	1,015,114	991,174
	4		975,937	1,304,948	1,463,084
	5		226,803	348,545	556,442
	S. Area		3,668,238	4,491,268	5,367,959
Preferred Alternative	1		431,133	663,998	836,068
	2		997,989	1,155,567	1,528,996
	3		1,071,621	1,032,492	996,775
	4		975,937	1,333,878	1,466,614
	5		233,788	352,130	556,443
	S. Area		3,710,468	4,538,065	5,384,896
EQ Alternative	1		431,133	663,998	836,068
	2		940,027	1,131,810	1,433,235
	3		1,071,621	1,032,492	996,775
	4		1,019,388	1,333,878	1,466,614
	5		233,947	336,947	530,601
	S. Area		3,696,116	4,499,125	5,263,293

Table 5-31 - CROPLAND RECEIVING NO TREATMENT (AC.)

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	573,856		632,237	
	2	970,967		1,035,156	
	3	1,111,924		1,108,800	
	4	1,364,288		1,586,746	
	5	261,084		313,932	
	S. Area	4,282,119		4,676,871	
Minimum OBERS Alternative	1		411,812	202,047	387,370
	2		618,550	229,672	576,665
	3		103,127	117,979	102,703
	4		112,192	54,112	17,112
	5		47,545	44,068	36,591
	S. Area		1,293,226	647,878	1,120,441
NED Alternative	1		156,499	133,679	121,779
	2		179,894	168,894	153,499
	3		82,999	87,439	70,119
	4		122,732	93,032	48,332
	5		80,109	75,509	74,979
	S. Area		622,233	558,553	468,708
Preferred Alternative	1		136,515	118,374	102,995
	2		178,768	168,968	155,273
	3		57,698	70,061	64,518
	4		122,271	63,641	44,341
	5		43,827	40,227	41,197
	S. Area		539,079	461,271	408,324
EQ Alternative	1		122,034	118,613	103,234
	2		178,164	168,364	153,564
	3		57,698	70,061	64,518
	4		112,045	53,265	34,115
	5		20,916	15,016	15,656
	S. Area		490,857	425,319	371,087

PASTURELAND TREATMENT

As shown in table 5-32, no pastureland would be left in continuous heavy use condition under future alternatives. Pastureland would be treated under a continuous moderate use or an improved grazing system. There would be a gradual decrease in pasture treated with continuous moderate use, even though acreage increased compared with present conditions. See table 5-33. The greatest increase in pastureland treated with continous moderate use would be for county groups 2 and 5.

Table 5-34 shows there would be a sharp increase in improved grazing systems, especially county group 3. However, because of a general decrease in pastureland production, acreages requiring such treatment would decline. Only the minimum OBERS production levels deviated from this trend. Pastureland classified as idle is not displayed because it is not generally considered an important part of a planned conservation treatment program. Total pastureland acreage, however, would include the idle category.

Table 5-32 - PASTURELAND IN CONTINUOUS HEAVY USE (AC.)

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	71,565		68,902	
	2	28,281		64,561	
	3	49,934		30,080	
	4	76,721		74,763	
	5	26,949		39,178	
	S. Area	253,450		277,484	
Minimum OBERS Alternative	1				
	2				
	3				
	4				
	5				
	S. Area				
NED Alternative	1				
	2				
	3				
	4				
	5				
	S. Area				
Preferred Alternative	1				
	2				
	3				
	4				
	5				
	S. Area				
EQ Alternative	1				
	2				
	3				
	4				
	5				
	S. Area				

Table 5-33 - PASTURELAND IN MODERATE USE (AC.)

Alternatives	County Group	1975	1985	2000	2020
Without Project Conditions	1	25,559		34,452	
	2	10,101		35,831	
	3	17,833		15,040	
	4	27,401		37,680	
	5	9,624		19,793	
	S. Area	90,518		142,796	
Minimum OBERS Alternative	1			---	
	2			---	
	3			---	
	4			---	
	5			75	
	S. Area			75	
NED Alternative	1		67,272	60,072	49,872
	2		38,295	48,495	63,195
	3		16,528	16,228	15,428
	4		77,369	73,869	68,869
	5		32,465	30,665	30,365
	S. Area		231,929	229,329	227,729
Preferred Alternative	1		67,272	60,072	49,872
	2		38,295	48,495	63,195
	3		16,528	16,228	15,428
	4		77,369	73,869	68,869
	5		32,465	30,665	30,365
	S. Area		231,929	229,329	227,729
EQ Alternative	1		67,272	60,072	49,872
	2		38,295	48,495	63,195
	3		16,528	16,228	15,428
	4		77,369	73,869	68,869
	5		32,465	30,665	30,363
	S. Area		231,929	229,329	227,729

Table 5-34 - PASTURELAND TREATED WITH IMPROVED GRAZING SYSTEMS (AC.)

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	5,112		11,483	
	2	2,020		10,860	
	3	3,567		5,014	
	4	5,480		12,459	
	5	1,925		6,527	
	S. Area	18,104		46,343	
Minimum OBERS Alternative	1		122,236	145,236	184,236
	2		72,402	111,102	169,002
	3		74,034	77,234	82,134
	4		132,202	159,402	200,002
	5		54,398	73,423	102,098
	S. Area		455,272	566,397	737,472
NED Alternative	1		11,190	9,490	5,990
	2		10,607	10,607	10,607
	3		46,306	31,206	12,506
	4		26,033	21,833	14,633
	5		6,061	5,561	5,361
	S. Area		100,197	78,697	49,097
Preferred Alternative	1		11,190	9,490	5,990
	2		10,607	10,607	10,607
	3		46,306	31,206	12,506
	4		26,033	21,833	14,633
	5		6,061	5,561	5,361
	S. Area		100,197	78,697	49,097
EQ Alternative	1		11,190	9,490	5,990
	2		10,607	10,607	10,607
	3		46,306	31,206	12,506
	4		26,033	21,833	14,633
	5		6,061	5,561	5,361
	S. Area		100,197	78,697	49,097

RANGELAND TREATMENT

Tables 5-35 and 5-36 show all rangeland in continuous heavy use was under present and future without project conditions. In contrast, based on data shown on table 5-37, there would be a sharp increase in rangeland treated with planned grazing systems. As expected, acreage would decrease from 1985 to 2020 because of conversion of rangeland to cropland. This only deviation from that decreasing acreage would be for the OBERS alternative which reached its peak by 2000. The sharpest increase in planned grazing was for county groups 1 and 4.

Rangeland treated by reseeding is greatest under minimum OBERS for 1985 (table 5-38). This is not a profitable practice compared with planned grazing systems on a long term basis, but was needed to meet the 1985 OBERS requirement. Several rangeland treatment alternatives including "Maintaining Existing Conditions" and "Idle" are not displayed because they are not an important part of a planned conservation treatment program.

Private forest land, using various treatments, does not vary for each alternative, therefore it was not displayed in this discussion. The acres of forest land receiving adequate treatment is estimated at over 180,000 acres. The acres of forest land receiving inadequate treatment is estimated at 357,600 acres not all of which is currently being grazed. Less than 2000 acres will be treated by reseeding.

Table 5-35 - RANGELAND IN CONTINUOUS HEAVY USE (AC.)

Alternatives	County Group	1975	1985	2000	2020
Without Project Conditions	1	2,464,419		2,612,479	
	2	1,452,253		1,331,700	
	3	592,116		581,892	
	4	2,031,644		1,840,931	
	5	1,266,315		1,167,790	
	S. Area	7,806,747		7,534,792	
Minimum OBERS Alternative	1				
	2				
	3				
	4				
	5				
	S. Area				
NED Alternative	1				
	2				
	3				
	4				
	5				
	S. Area				
Preferred Alternative	1				
	2				
	3				
	4				
	5				
	S. Area				
EQ Alternative	1				
	2				
	3				
	4				
	5				
	S. Area				

Table 5-36 - RANGELAND IN CONTINUOUS PROPER USE (AC.)

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	2,276,603		2,049,186	
	2	2,542,614		2,483,117	
	3	477,183		471,847	
	4	2,461,886		2,342,777	
	5	1,094,268		1,044,578	
	S. Area	8,852,554		8,391,505	
Minimum OBERS Alternative	1				
	2				
	3				
	4				
	5				
	S. Area				
NED Alternative	1				
	2				
	3				
	4				
	5				
	S. Area				
Preferred Alternative	1				
	2				
	3				
	4				
	5				
	S. Area				
EQ Alternative	1				
	2				
	3				
	4				
	5				
	S. Area				

Table 5-37 - RANGELAND TREATED WITH PLANNED GRAZING SYSTEMS (AC.)

Alternatives	County Group	1975	1985	2000	2020
		Time Periods			
Without Project Conditions	1	24,142		23,399	
	2	9,505		8,661	
	3	1,116		1,342	
	4	10,358		9,511	
	5	26,910		37,644	
	S. Area	72,031		80,557	
Minimum OBERS Alternative	1		3,289,415	4,350,582	4,065,566
	2		2,856,357	3,715,872	3,686,552
	3		723,683	946,890	900,732
	4		3,164,437	3,914,509	3,793,978
	5		1,714,463	2,130,146	2,017,133
	S. Area		11,748,355	15,057,999	14,463,961
NED Alternative	1		4,530,020	4,262,431	3,861,666
	2		3,813,672	3,585,172	3,240,372
	3		995,490	943,632	839,832
	4		4,101,453	3,815,778	3,245,778
	5		2,213,172	2,044,533	1,763,633
	S. Area		15,653,807	14,651,546	12,951,281
Preferred Alternative	1		4,530,020	4,262,431	3,861,666
	2		3,813,672	3,585,172	3,240,372
	3		995,490	943,632	839,832
	4		4,101,453	3,815,778	3,245,778
	5		2,213,172	2,044,533	1,763,633
	S. Area		15,653,807	14,651,546	12,951,281
EQ Alternative	1		4,530,020	4,262,431	3,861,666
	2		3,813,672	3,585,172	3,240,372
	3		995,490	943,632	839,832
	4		4,101,453	3,815,778	3,245,778
	5		2,213,172	2,044,533	1,763,633
	S. Area		15,653,807	14,651,546	12,951,281

Table 5-38 - RANGELAND TREATED BY RESEEDING (AC.)

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	---		400	
	2	---		20,940	
	3	218		13,251	
	4	790		21,949	
	5	340		8,120	
	S. Area	1,348		64,660	
Minimum OBERS Alternative	1		1,360,251	1,887	
	2		1,134,955	---	
	3		326,949	12,842	
	4		1,309,015	70,269	
	5		673,370	33,787	
	S. Area		4,804,540	118,785	
NED Alternative	1		7,631		
	2		---		
	3		17,742		
	4		90,225		
	5		14,251		
	S. Area		129,849		
Preferred Alternative	1		7,631		
	2		---		
	3		17,742		
	4		90,225		
	5		14,251		
	S. Area		129,849		
EQ Alternative	1		7,631		
	2		---		
	3		17,742		
	4		90,225		
	5		14,251		
	S. Area		129,849		

LAND TREATMENT COSTS

The cost of land treatment is an important part of the total production cost. For example, the estimated land treatment cost for preferred conditions compared with total production cost for the various time periods is shown below:

Time Frame	Total Production	Land Treatment* Measures Ave. Annual Cost	Percent Land Treatment Cost are of Total Production Cost
1985	$152,609,652	$37,829,000	24.8%
2000	179,812,841	39,614,500	22.0%
2020	221,795,664	41,566,700	18.7%

* Includes cost of rural water system which is part of a planned grazing system.

Data indicate land treatment costs are from 18 to 23 percent of the total production cost. These data also suggest various land treatment practices which would be installed will be a smaller portion of all cost by 2020.

The cost of installing various land treatment measures would increase dramatically for all alternatives displayed when compared with present and future without project conditions (table 5-39). As expected, more land treatment will result in increased installation cost. Because less grassland and rangeland would be converted to cropland with the EQ alternative, the relative land treatment cost would be less. Also, the greatest amount of land treatment cost would be for county groups 1, 2, and 4 for all alternatives except minimum OBERS.

Installing and maintaining needed land treatment measures on cropland would cost more than 50 percent of all treatment costs, except for the minimum OBERS alternative. See tables 5-40, 41, 42. Land treatment cost on cropland would be the greatest for county groups 2, 3, and 4 except for minimum OBERS alternatives where group 5 has the largest cost. The greatest portion of these costs is for the installation of terraces, windstrips, and windbreaks.

Minimum OBERS alternative would have the greatest cost of the various plans for installing land treatment on pastureland (table 5-41). This cost would not increase as much under future conditions because production decreases. Land treatment measures on pastureland would be the greatest for county group 4. The largest amount of money would be spent on improving grazing systems under minimum OBERS while larger amounts would be spent on management systems grazed under a continuous moderate use because of the larger acreage involved.

Because of decreased rangeland acreage projected through 2020, related land treatment costs would decrease over time. See table 5-42. The largest cost of treatment would involve expenditures on planned grazing systems. The largest portion of funds would be spent on developing grazing systems on rangeland adequately or inadequately treated. Most of the expenditures would be spent for maintaining or building new fences and adding more water facilities.

Under preferred conditions 53 percent of treatment cost would be for cropland; 42 percent for rangeland; and the remaining 5 percent for pastureland. 1/ Thus, even though rangeland production declines over time to 2020, a large portion of the treatment cost would be for improving range conditions. For example, nearly half of the land treatment cost would be for improving rangeland under minimum OBERS production. Therefore, rangeland improvement would continue to be an important factor as part of the goal to maximize net returns.

1/ The treatment costs are limited to cropland, pastureland, and rangeland, because only on-going treatment was considered on private forest land, and these treatment costs were not estimated.

Table 5-39 - TOTAL LAND TREATMENT COSTS (DOLLARS) 1/

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	4,403,167		4,405,737	
	2	3,418,953		3,753,363	
	3	1,308,611		1,247,149	
	4	4,207,227		4,174,915	
	5	2,127,252		2,236,600	
	S. Area	15,465,210		15,817,764	
Minimum OBERS Alternative	1		11,018,780	8,818,669	9,039,201
	2		9,294,712	9,419,320	7,565,294
	3		6,569,488	6,129,856	6,088,624
	4		12,643,759	11,129,874	10,332,452
	5		5,405,861	4,157,429	4,232,669
	S. Area		44,932,600	39,655,148	37,258,240
NED Alternative	1		7,284,252	7,911,374	8,227,500
	2		8,608,236	9,166,279	10,438,862
	3		6,236,553	5,805,048	5,490,286
	4		9,737,153	10,438,783	10,574,069
	5		3,671,359	3,974,570	4,546,789
	S. Area		35,537,553	37,296,054	39,277,506
Preferred Alternative	1		7,317,114	7,911,435	8,228,403
	2		8,620,941	9,156,333	10,497,442
	3		6,355,468	5,886,725	5,609,045
	4		9,737,153	10,574,451	10,590,660
	5		3,704,390	3,991,620	4,547,279
	S. Area		35,735,066	37,520,564	39,472,829
EQ Alternative	1		7,322,084	7,912,872	8,229,841
	2		8,408,445	9,092,188	10,162,653
	3		6,355,468	5,886,725	5,609,045
	4		9,891,846	10,577,416	10,593,274
	5		3,710,833	3,932,644	4,442,588
	S. Area		35,688,676	37,401,845	39,037,401

1/ An estimated cost of $2,093,900 should be added to each of the study area totals, except for without project conditions. Rural water systems need to be installed on an estimated 3 million acres of rangeland as part of a planned grazing system.

Table 5-40 - LAND TREATMENT COSTS ON CROPLAND (DOLLARS)

Alternatives	County Group	1975	1985	2000	2020
		Time Periods			
Without Project Conditions	1	56,001		62,950	
	2	114,553		131,787	
	3	96,665		93,351	
	4	114,960		143,201	
	5	36,232		70,211	
	S. Area	418,411		501,500	
Minimum OBERS Alternative	1		1,152,186	2,374,229	2,468,633
	2		1,556,669	4,330,747	1,850,974
	3		3,756,787	4,162,163	4,168,660
	4		3,112,734	4,890,275	4,028,922
	5		485,313	845,204	839,865
	S. Area		10,063,689	16,602,618	13,357,054
NED Alternative	1		1,849,560	2,852,864	3,692,364
	2		4,399,541	5,150,329	6,717,067
	3		4,474,127	4,342,227	4,363,765
	4		4,397,075	5,809,550	6,674,966
	5		991,287	1,537,794	2,420,878
	S. Area		16,111,590	19,692,764	23,869,040
Preferred Alternative	1		1,882,422	2,852,925	3,693,267
	2		4,412,246	5,140,383	6,775,647
	3		4,593,042	4,423,904	4,482,524
	4		4,397,075	5,945,218	6,691,557
	5		1,024,318	1,554,844	2,421,368
	S. Area		16,309,103	19,917,274	24,064,363
EQ Alternative	1		1,887,392	2,854,362	3,694,705
	2		4,199,750	5,076,238	6,440,858
	3		4,593,042	4,423,904	4,482,524
	4		4,551,768	5,948,183	6,694,171
	5		1,030,761	1,495,868	2,316,677
	S. Area		16,262,713	19,798,555	23,628,935

Table 5-41 - LAND TREATMENT COSTS ON PASTURELAND (DOLLARS)

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	512,715		610,928	
	2	202,614		589,019	
	3	357,742		266,717	
	4	549,653		664,180	
	5	193,068		348,235	
	S. Area	1,815,792		2,479,079	
Minimum OBERS Alternative	1		1,387,379	1,648,429	2,091,078
	2		821,763	1,261,008	1,918,173
	3		840,286	876,606	932,221
	4		1,500,493	1,809,213	2,270,023
	5		617,417	833,677	1,158,812
	S. Area		5,167,338	6,428,933	8,370,307
NED Alternative	1		419,640	369,025	284,930
	2		286,972	331,342	395,287
	3		597,470	424,780	209,055
	4		632,030	569,135	465,665
	5		210,015	196,510	192,935
	S. Area		2,146,127	1,890,792	1,547,872
Preferred Alternative	1		419,640	369,025	284,930
	2		286,972	331,342	395,287
	3		597,470	424,780	209,055
	4		632,030	569,135	465,665
	5		210,015	196,510	192,935
	S. Area		2,146,127	1,890,792	1,547,872
EQ Alternative	1		419,640	369,025	284,930
	2		286,972	331,342	395,287
	3		597,470	424,780	209,055
	4		632,030	569,135	465,665
	5		210,015	196,510	192,935
	S. Area		2,146,127	1,890,792	1,547,872

Table 5-42 - LAND TREATMENT COSTS ON RANGELAND (DOLLARS) 1/

Alternatives	County Group	Time Periods 1975	1985	2000	2020
Without Project Conditions	1	3,834,451		3,731,859	
	2	3,101,786		3,032,557	
	3	854,204		887,081	
	4	3,542,614		3,367,534	
	5	1,897,952		1,818,154	
	S. Area	13,231,007		12,837,185	
Minimum OBERS Alternative	1		8,479,215	4,796,011	4,479,490
	2		6,916,280	3,827,565	3,796,147
	3		1,972,415	1,091,087	987,743
	4		8,030,532	4,430,386	4,033,507
	5		4,303,131	2,478,548	2,233,992
	S. Area		29,701,573	16,623,597	15,530,879
NED Alternative	1		5,015,052	4,689,485	4,250,206
	2		3,921,723	3,684,608	3,326,508
	3		1,164,956	1,038,041	917,466
	4		4,708,048	4,060,098	3,433,438
	5		2,470,057	2,240,266	1,932,976
	S. Area		17,279,836	15,712,498	13,860,594
Preferred Alternative	1		5,015,052	4,689,485	4,250,206
	2		3,921,723	3,684,608	3,326,508
	3		1,164,956	1,038,041	917,466
	4		4,708,048	4,060,098	3,433,438
	5		2,470,057	2,240,266	1,932,976
	S. Area		17,279,836	15,712,498	13,860,594
EQ Alternative	1		5,015,052	4,689,485	4,250,206
	2		3,921,723	3,684,608	3,326,508
	3		1,164,956	1,038,041	917,466
	4		4,708,048	4,060,098	3,433,438
	5		2,470,057	2,240,266	1,932,976
	S. Area		17,279,836	15,712,498	13,860,594

1/ An estimated cost of $2,093,900 should be added to each of the study area totals, except for without project conditions. Rural water systems need to be installed on an estimated 3 million acres of rangeland as part of a planned grazing system.

WILDLIFE HABITAT EVALUATIONS

Wildlife habitat potentials for the five alternatives are expressed for the overall percent developed, and for the resulting acre value for farmland wildlife and for rangeland wildlife in tables 5-43 and 5-44. Tables 5-45 and 5-46 compare alternatives, land use factors and quality factors for these same kinds of wildlife. A definition of terms is found in Appendix D.

The key element in obtaining a land use factor is the habitat value factor (see Appendix D - Wildlife Habitat Evaluation, Table B). Tables providing habitat value factors for farmland wildlife and rangeland wildlife were developed at the SCS Midwest Technical Service Center, Lincoln, Nebraska, from literature reviews, and from field experience gained mainly in Kansas and Nebraska.

The land use factor does not involve management strategies. Only the percent occurrence for each of five different land uses provides the habitat value factors used in computing land use factors.

Quality factors are computed using quality ratings (see Appendix D - Wildlife Habitat Evaluation, Tables D, E, F, G, and H) established for cropland rotations and grassland management systems. (See Appendix B for management strategy LP code descriptions.) Quality ratings were estimated from literature reviews and from field experience in South Dakota.

Rotations and management strategies by acres for applicable land use are multipled by their quality ratings to provide acre values. These values are totaled (see Appendix D - Wildlife Habitat Evaluation, Table I) and computed for a single quality factor for each alternative and kind of wildlife.

The land use factor and the quality factor, obtained for each alternative are given equally weighted value in computing percent developed. The total planned acreage, consistent in all alternatives, multiplied by the potentially variable percent developed gives the acre value for each alternative.

The 5 alternatives for which these wildlife evaluations were made included 2 time frames of without project conditions, and 3 alternatives of one time frame involving a mix of objectives and constraints (see Appendix D). Tables 5-43 through 5-47 compare the percent developed for wildlife by alternatives and kinds of wildlife.

A COMPARISON OF ALTERNATIVES FOR THEIR WILDLIFE POTENTIALS

Table 5-43 - FARMLAND WILDLIFE

Name of Alternative	Percent Developed	Acre Value
1975 Without Project Conditions	50	11,350,635
Year 2000 Without Project Conditions	57	12,939,724
Year 2000 Preferred Alternative	72	16,344,914
Year 2000 NED Alternative	72	16,344,914
Year 2000 EQ Alternative	72	16,344,914

Table 5-44 - RANGELAND WILDLIFE

Name of Alternative	Percent Developed	Acre Value
1975 Without Project Conditions	62	14,074,787
Year 2000 Without Project Conditions	51	11,577,647
Year 2000 Preferred Alternative	52	11,804,660
Year 2000 NED Alternative	52	11,804,660
Year 2000 EQ Alternative	52	11,804,660

Table 5-45 - FARMLAND WILDLIFE

Name of Alternative	Land Use Factors	Quality Factor
1975 Without Project Conditions	.53	.47
Year 2000 Without Project Conditions	.68	.47
Year 2000 Preferred Alternative	.78	.66
Year 2000 NED Alternative	.78	.66
Year 2000 EQ Alternative	.78	.65

Table 5-46 - RANGELAND WILDLIFE

Name of Alternative	Land Use Factors	Quality Factor
1975 Without Project Conditions	.82	.42
Year 2000 Without Project Conditions	.59	.42
Year 2000 Preferred Alternative	.52	.52
Year 2000 NED Alternative	.52	.52
Year 2000 EQ Alternative	.52	.52

Table 5-47 - FARMLAND WILDLIFE - RANGELAND WILDLIFE

Name of Alternative	Percent Developed for Wildlife 1/ Farmland	Rangeland
1975 Without Project Conditions	50	62
Year 2000 Without Project Conditions	57	51
Year 2000 Preferred Alternative	72	52
Year 2000 NED Alternative	72	52
Year 2000 EQ Alternative	72	52

1/ Percent Developed for Wildlife - the degree (percent) to which lands have a development potential for wildlife. The ultimate potential would be 100 percent under wildlife land use and management.

DISCUSSION

The most significant inferences provided by this evaluation are:

(1) That the development potential for farmland wildlife increases between years 1975 and 2000 (+22%); while rangeland wildlife decreases (10%); and

(2) That for both kinds of wildlife the development potential is the same for the Preferred Alternative, NED Alternative, and the EQ Alternative.

In this evaluation the development potential for farmland wildlife and rangeland wildlife as quantified by the percent developed or acre value is tied to land use and management for agricultural production.

The ultimate potential of wildlife would occur where farmland wildlife or rangeland wildlife were 100 percent developed under a wildlife land use. This ultimate potential could not occur in the same time frame for both kinds of wildlife on a given area of land.

It would also be true that the actual wildlife production for either kind of wildlife would be higher under a wildlife land use than under agricultural land uses where the percent developed using this system was the same for both.

REGIONAL ECONOMIC IMPACTS

Total regional economic impacts were calculated for each alternative and time period. The calculations were made with the economic input-output model described in Chapter 4. The prices were held constant at current 1977 prices for all time periods. However, technology or output per person hour of labor was assumed to increase at 1 1/2 percent per year for agriculture sectors and at 1 percent per year for non-agriculture sectors.

These direct, indirect, and induced effects relate to employment, income, gross regional product, and total sales. (See discussion of the impacts of input-output model found in Appendix C.) The total impact and the change from future without project condition for 2000 for each alternative and year is presented in Table 5-48. The exact number shows the preferred alternative to have the greatest impact for each year. However, due to the available data and method of estimation, there is little statistical difference between any alternative when compared with the future without project condition for 2000.

The results of this analysis indicate that it would be impossible to choose between the four alternatives (Minimum OBERS, NED, Preferred, or EQ) on the basis of impact on the regional economy. The analysis does show, however, that any of the alternatives would have a substantial effect on the regional economy over the prespecified conditions, and that agriculture is and will continue to be an important industry in western South Dakota.

Table 5-48 - REGIONAL SOCIO-ECONOMIC IMPACTS

Alternative Economic Indicators	Units	1975	1985	2000	Change From Future Without Project	2020
Future Without Project Conditions						
Total Employment	M Person-Years	26.0		21.6		
Women Employed	M Person-Years	3.6		2.8		
Minorities Employed	M Person-Years	1.5		1.2		
Income	MM 1977 $	270.2		304.4		
Gross Regional Product	MM 1977 $	611.0		683.1		
Total Sales	MM 1977 $	995.2		1079.0		
Minimum OBERS						
Total Employment	M Person-Years		32.1	32.5	10.9	27.8
Women Employed	M Person-Years		4.2	4.3	1.5	3.5
Minorities Employed	M Person-Years		1.9	1.8	0.6	1.5
Income	MM 1977 $		378.4	459.4	155.0	502.4
Gross Regional Product	MM 1977 $		869.9	1034.7	351.6	1128.0
Total Sales	MM 1977 $		1353.4	1631.5	552.5	1789.1
NED Alternative						
Total Employment	M Person-Years		38.5	37.5	15.9	34.3
Women Employed	M Person-Years		5.2	5.0	2.2	4.4
Minorities Employed	M Person-Years		2.3	2.1	0.9	1.8
Income	MM 1977 $		452.6	527.3	222.9	617.4
Gross Regional Product	MM 1977 $		1017.0	1175.1	492.0	1353.7
Total Sales	MM 1977 $		1599.1	1862.4	783.4	2172.0
Preferred Alternative						
Total Employment	M Person-Years		38.6	37.5	15.9	34.8
Women Employed	M Person-Years		5.2	5.0	2.2	4.5
Minorities Employed	M Person-Years		2.3	2.1	0.9	1.9
Income	MM 1977 $		453.0	527.5	223.1	625.5
Gross Regional Product	MM 1977 $		1017.8	1175.3	492.2	1370.5
Total Sales	MM 1977 $		1600.4	1862.7	783.7	2199.6
EQ Alternative						
Total Employment	M Person-Years		37.8	36.8	15.2	29.9
Women Employed	M Person-Years		5.1	4.9	2.1	3.8
Minorities Employed	M Person-Years		2.2	2.1	0.9	1.6
Income	MM 1977 $		444.0	518.7	214.3	538.6
Gross Regional Product	MM 1977 $		998.9	1157.0	473.9	1188.3
Total Sales	MM 1977 $		1569.7	1832.8	753.8	1900.6

1/ M means 1,000.

2/ MM means 1,000,000.

FEDERAL LAND SECTOR IMPACTS

Several Federal Government agencies manage 3,154,239 acres of public land in the Western South Dakota River Basins. Much of this land is managed under the multiple use principle. However, public ownership of some of this land is for a single purpose. Since the management goals and objectives are different and soil and resource data are not fully available in the form used in the private land model, federal land was analysed separate from the state and private land.

Each federal land managing agency was asked to inventory the total land it manages. The inventory included the (1) total acres and acres currently being grazed in each of four management strategies; (2) total acres and acres anticipated 1/ being grazed in each of the four management strategies by 2000; (3) total acres and acres being grazed in each of the four management strategies by 2000 under optimal management; 2/ (4) animal units of grazing associated with each acre and management strategy.

The four management strategies are:

(1) Environmental management with livestock.
Range utilized by livestock is within the apparent present capacity of the environmental conditions of the range. Investments for range management are applied only to the extent required to maintain the environment at a stewardship level in the presence of grazing. Investments for implementation may be very low. The goal is to attain livestock control. Little attempt is made to achieve grazing distribution, except by use of salt.

(2) Extensive management of environment and livestock.
Management systems and techniques, including fencing and water developments, are applied as needed to obtain relatively uniform grazing distribution and plant use, and to maintain plant vigor. Management seeks full utilization of the animal unit months available for livestock grazing. No attempt is made to maximize livestock forage production by cultural practices such as seeding.

(3) Intensive management of environment and livestock, through vegetative manipulation. Undesirable vegetation may be replaced through improvement in growing conditions, i.e. spraying, seeding, chaining, etc.

1/ Anticipated future management means that level of production achieved by 2000 assuming a continuation of all current government programs and private effort.

2/ Optimal future management means that level of production achieved by 2000 by applying the most intensive range management activity which is appropriate. These estimates are made by each respective federal land managing agency.

(4) Intensive management of the environment and livestock.
All combinations of available technology for range and livestock management is considered. Management seeks to maximize livestock forage production consistent with constraints of maintaining the environment and providing for multiple use. Undesirable vegetation may be replaced through improvement in growing conditions. Structures may also be installed to accommodate complex livestock management systems and practices.

As agencies attempted to relate the four management strategies to their individual management activities, inconsistent agency interpretation of the four strategies probably occurred. Also, separate agency assumptions as to the difference between anticipated and optimal futures probably resulted in additional variation in approach. For these reasons, the actual numbers shown on Tables 5-49 through 5-52 may not be valid for more than a general understanding of combined federal agency opportunities.

The soil loss was calculated using the Universal Soil Loss Equation for the range types and management strategies under consideration. Because of the nature of the data and the procedure used, indicated differences in the total soil loss as between current, anticipated and otimal futures cannot be considered significant.

The cost rationale came from the methology presented in "The Nation's Range Resource, A Forest-Range Environmental Study", U.S. Department of Agriculture, Forest Resource Report No. 19, page 107. Construction and project implementation costs were determined and amortized over the length of life of the structure or project. To this annual cost was added annual maintenance and repair costs. The 1970 costs in the above publication were updated to 1977 using the prices paid by farmers index.

The results of this survey and analysis are presented in tables 5-49 through 5-52. The federal agencies expect an increase in grazed land of 250,000 acres in 2000 when compared with current conditions. They also anticipate a change from 12 percent in stewardship type management (strategy 1) currently to less than 1 percent in the year 2000. The costs for the anticipated future are over $2 million per year more than the current costs. If an AUM is valued at $9 per AUM, as it is in the private land part of this report, benefits from grazing would only increase by slightly more than $1 million. The apparent excess cost over benefits may come about partly through a need to overcome existing problems and to provide proper management for even the current level of livestock use.

In comparing the anticipated future with what the agencies conceive to be optimal, the acres grazed decrease slightly. Costs increase by more than $100 thousand, but AUM's also increase by more than 130 thousand. More intensive management results in these increased costs and output in AUM's. With the $9 per AUM value, benefits go up by $1.2 million compared to a cost increase of $.1 million.

Soil loss increases by about 200 thousand tons per year in the anticipated future compared to the present situation. But here again the optimal future would have slightly less soil loss even when producing more AUM's. This is a result of more intensive management with improved environment as an objective.

Federal lands are not considered in the preferred alternative in this report. It is not the intent of this report to make recommendations to the federal agencies, since livestock grazing and soil loss are the only variables examined in this study. Any recommendation probably would not be useful for the land managing agencies. However, the data present in the tables should be of use to them.

Table 5-49 - FEDERAL LAND GRAZED (ACRES) 1/

Alternatives	County Group	Range Management Strategies 1	2	3	4	Total
Current Management 1975	1	55,499	281,287	34,520	60,640	431,946
	2	115,019	67,540	57,590	0	240,149
	3	10,905	60,621	0	0	71,526
	4	17,428	169,010	0	4,300	190,738
	5	36,184	633,679	50,790	249,200	969,853
	Total	235,035	1,212,137	142,900	314,140	1,904,212
Anticipated Future Management 2000	1	5,527	346,100	0	193,100	544,727
	2	5,867	9,900	0	150,118	165,885
	3	180	57,589	0	3,032	60,801
	4	400	162,758	0	7,610	170,768
	5	910	819,415	13,000	384,334	1,217,659
	Total	12,884	1,395,762	13,000	738,194	2,159,840
Optimal Future Management 2000	1	5,167	346,100	0	193,100	544,367
	2	5,867	9,900	0	150,118	165,885
	3	0	54,740	0	6,061	60,801
	4	0	155,548	0	15,220	170,768
	5	2,010	780,427	13,000	407,667	1,203,099
	Total	13,044	1,346,710	13,000	772,166	2,144,920

1/ Does not include land managed by Bureau of Indian Affairs.

Table 5-50 - FEDERAL LAND - SOIL LOSS FROM GRAZED ACRES (TONS/YEAR) 1/

Alternatives	County Group	Range Management Strategies 1	2	3	4	Total
Current Management 1975	1	141,231	403,588	24,164	60,640	629,623
	2	387,206	103,238	56,627	0	547,071
	3	55,615	157,615	0	0	213,230
	4	71,454	303,044	0	4,300	378,798
	5	108,552	950,520	35,553	249,200	1,343,825
	Total	764,058	1,918,005	116,344	314,140	3,112,547
Anticipated Future Management 2000	1	16,581	481,650	0	252,150	750,381
	2	21,781	14,850	0	237,201	273,832
	3	918	149,731	0	7,883	158,532
	4	1,360	292,245	0	13,468	307,073
	5	2,730	1,229,123	9,100	576,502	1,817,455
	Total	43,370	2,167,599	9,100	1,087,204	3,307,273
Optimal Future Management 2000	1	15,501	481,650	0	252,150	749,301
	2	17,601	14,850	0	237,201	269,652
	3	0	142,324	0	15,759	158,083
	4	0	279,456	0	26,938	306,394
	5	6,910	1,170,634	9,100	611,501	1,798,145
	Total	40,012	2,088,914	9,100	1,143,549	3,281,575

1/ Does not include land managed by Bureau of Indian Affairs.

Table 5-51 - ANIMAL UNIT MONTHS FROM GRAZED FEDERAL LAND 1/

Alternatives	County Group	Range Management Strategies 1	2	3	4	Total
Current Management 1975	1	20,138	83,261	10,321	17,707	131,427
	2	42,556	19,992	17,220	0	79,768
	3	4,035	17,944	0	0	21,979
	4	6,449	50,027	0	1,256	57,732
	5	13,389	187,569	15,186	72,766	288,910
	Total	86,567	358,793	42,727	91,729	579,816
Anticipated Future Management 2000	1	2,103	99,700	0	57,550	159,353
	2	940	3,300	0	79,009	83,249
	3	18	23,035	0	7,580	30,633
	4	40	55,379	0	19,025	74,444
	5	455	194,806	4,000	149,135	348,396
	Total	3,556	376,220	4,000	312,299	696,075
Optimal Future Management 2000	1	2,067	133,650	0	64,188	199,905
	2	2,212	4,950	3,000	100,079	110,241
	3	0	27,370	0	15,152	42,522
	4	0	56,014	0	38,049	94,063
	5	455	175,683	1,000	207,467	384,605
	Total	4,734	397,667	4,000	424,935	831,336

1/ Does not include land managed by Bureau of Indian Affairs.

Table 5-52 - CONSTRUCTION, MAINTENANCE, REPAIR COSTS ON GRAZED FEDERAL LAND 1/ 1977 PRICES - (AVERAGE ANNUAL COSTS)

Alternatives	County Group	Range Management Strategies 1	2	3	4	Total
Current Management 1975	1	72,703	503,504	149,471	371,117	1,096,795
	2	150,675	120,897	249,365	0	520,937
	3	14,285	108,511	0	0	122,796
	4	22,831	302,528	0	26,316	351,675
	5	47,401	1,134,285	219,921	1,525,104	2,926,711
	Total	307,895	2,169,725	618,757	1,922,536	5,018,914
Anticipated Future Management 2000	1	7,240	619,519	0	1,181,772	1,808,531
	2	7,686	17,721	0	918,722	944,129
	3	236	103,084	0	18,556	121,876
	4	524	291,337	0	46,673	338,534
	5	1,192	1,466,753	56,290	2,352,124	3,876,359
	Total	16,878	2,498,414	56,290	4,517,847	7,089,429
Optimal Future Management 2000	1	6,768	619,519	0	1,181,772	1,808,059
	2	7,686	17,721	0	918,722	944,129
	3	0	97,985	0	37,093	135,078
	4	0	278,431	0	93,146	371,577
	5	2,633	1,396,964	56,290	2,494,922	3,950,809
	Total	17,087	2,410,610	56,290	4,725,655	7,209,652

1/ Does not include land managed by Bureau of Indian Affairs.

IMPACTS OF GRAZING FEDERAL LAND

The impacts of grazing federal land were calculated using the economic input-output model for Western South Dakota. The 1975 impacts show how much of the current economic activity is associated with the grazing of federal lands. The economic activity is developed by the private lessee and is calculated by the amount of livestock sold per animal unit month of grazing. The economic activity included the direct effect on the agriculture livestock sector, the indirect effects on the other sectors in the economy that supply inputs to the agriculture livestock sector, and finally the induced effect, which is the result of the owners and employees of the direct and indirectly affected sectors spending their incomes in the region.

	Current 1975	Anticipated Future 2000	Optimal Future 2000
Employment (M person-years) 1/	.984	.827	.989
Women employed (M person-years)	.145	.116	.139
Minorities employed (M person-years)	.061	.048	.139
Income (MM $) 2/	10.11	11.5	13.7
Gross Regional Product (MM $)	21.2	24.1	28.8
Total Sales (MM $)	34.4	39.4	47.0

Impacts are in current 1977 dollars, but assume technology, i.e., output per employee, increase 1.5 percent per year in agriculture sectors and 1.0 percent per year in non-agriculture sectors.

1/ M means 1000.
2/ MM means 1,000,000.

PREFERRED ALTERNATIVE

CHAPTER 6

Preferred Alternative

Introduction

The desired future conditions were based on discussions with sponsors and other interested groups and agencies. These sponsors which represented two West River Conservancy Sub-Districts and two state agencies provided much of their input for development of the preferred alternative during discussions at FAC meetings. Additional public involvement included comments made by conservation district supervisors, district and area conservationists, and representatives from several state agencies. Many of the suggestions provided by these represenatives were based on a concensus of comments made by local people in their respective communities. As stated in Chapter 5, this alternative was developed to meet a combination of the NED and EQ objectives. This set of conditions referred to as the "preferred alternative", resulted in the most profitable agricultural production for the limited number of alternatives evaluated while keeping soil loss below tolerable limits. This alternative would reflect the actions required to best achieve these desired conditions. This would require land use conversions, conservation tillage, irrigation development, land treatment, and various cropping rotations.

This alternative also measured the effects of these elements in terms of net income, soil loss, land use changes, crop production, treatment costs, and wildlife habitat development.

Following is a discussion and display of these elements and effects.

Net Income

The projected land use changes would increase net revenue from $205,002,000 under future without project conditions to $444,583,000 under desired future conditions. The largest increase in net revenue would occur in county group 4. Soil losses would be maintained at tolerable levels even though there would be a sharp increase in row crop production.

Soil Loss

Soil losses from water erosion would be reduced by over 16 million tons under desired future conditions. In contrast, wind erosion would increase soil losses of 1 million tons annually. Thus, a net reduction of over 14 million tons of soil lost because of erosion would be anticipated. This would be the result of improved conservation practices and better management of the land even though a significant increase in cropland is required to maximize net revenue.

Land Use Conversions

One of the characteristics of the model is the opportunity to change land use to maximize net returns. The following data shows the conversions from the future without project conditions to the preferred alternatives for year 2000:

Conversion		Acres
1. Adequate Rangeland to Non-irrigated Cropland 1/	+	532,355
2. Inadequate Rangeland to Non-irrigated Cropland 1/	+	371,987
3. Reseed Range to Non-irrigated Cropland 1/	+	15,627
4. Pastureland to Non-irrigated Cropland	+	29,681
5. Non-irrigated Cropland to Rangeland	+	128,295
6. Non-irrigated Cropland to Pastureland	-	104,270
7. Non-irrigated to Irrigated Cropland	-	11,981

The most dominant conversion is the conversion of rangeland to non-irrigated cropland. For some soil resource groups given management strategies, it would be beneficial to convert cropland to rangeland in order to keep soil losses within tolerable levels. There is a large number of acres of pastureland converted to non-irrigated cropland in order to maximize net revenue.

Crop Production Patterns

In order to maximize net revenue, an increase in production of most crops would be required. The change for each of the crops included in the evaluation follows:

1/ Three rangeland conditions were used: Rangeland adequately treated, rangeland inadequately treated, and rangeland needing reseeding.

Crop	Unit	Production Levels: Future Without Project Conditions 2000	Production Levels: Desired Future Conditions - 2000	Net changes in Production	Percent Change
Corn	Bu.	8,559,261	10,008,752	+ 1,449,491	+ 17
Corn Silage	Tons	1,536,970	4,486,834	+ 2,949,864	+192
Sorghum	Bu.	2,579,367	9,586,067	+ 7,006,700	+272
Sorghum Silage	Tons	32,577	---	- 32,577	-100
Wheat	Bu.	28,959,270	72,835,956	+43,876,686	+152
Oats	Bu.	20,494,450	32,631,768	+12,187,318	+ 59
Alfalfa	Tons	1,888,794	1,993,995	+ 105,201	+ 6
Other Hay	Tons	403,143	5,803	- 397,340	- 99
Range	AUM	6,310,228	9,755,259	+ 3,445,031	+ 55

Wheat, sorghum, and corn silage would have the largest percentage increase in production. Production levels of sorghum produced for silage and other hay will decrease. Selective land treatment practices and increases in conservation tillage will be required to keep soil losses at tolerable levels as crop output increases.

Tillage Methods

Changes are required in tillage methods to maintain soil losses at tolerable levels under desired future conditions. The needed increase in conservation tillage follows:

Tillage Method	Future Without Project Conditions - 2000 (Ac.)	Desired Future Condition - 2000 (Ac.)	Net Change
Conventional	1,643,887	302,721	-1,341,166
Conservation	2,456,018	6,274,071	+3,818,053

Land Treatment

Land treatment is needed to maintain soil losses within tolerable levels under desired future conditions. Needed increases in land treatment on cropland are shown below.

Treatment	Acres in Study Area: Future without Project Conditions - 2000	Desired Future Condition - 2000	Net Change
No Treatment	4,676,871	461,271	-4,215,600
Contouring	78,620	106,842	+ 28,222
28,222 Windstrip/ Windbreak	678,416	1,635,434	+ 957,018
Contour Strip	22,485	203,830	+ 181,345
Terraces	63,425	4,538,065	+4,474,640

Application of land treatment measures will increase costs.

Less conservation treatment is needed to maintain pastureland soil losses at tolerable levels. Most treatment would be required on pastureland receiving continuous moderate grazing or a planned grazing system.

Planned grazing systems on rangeland would increase more than 14 million acres under desired future conditions. Rangeland presently managed under either continuous heavy use or proper use would convert to a planned grazing system as shown below:

Range Condition and Treatment	Acres in Study Area: Future Without Project Conditions - 2000	Desired Future Condition - 2000	Net Changes
Continuous Heavy Use	7,534,792	0	- 7,534,792
Continuous Proper Use	8,391,505	0	- 8,391,505
Planned Grazing System	80,557	14,651,546	+14,570,989

These changes in treatment of rangeland would result in increased treatment costs.

Land Treatment Costs

Land treatment costs in the year 2000 will increase from $15 million under future without project conditions to $39 million under desired future conditions. The estimate land use treatment costs are shown below:

		Dollar Cost
Cropland	-	$19,917,274
Pastureland	-	1,890,792
Rangeland	-	17,806,400
Total		$39,614,466

Average annual land treatment costs are an estimated 20 percent of total production costs. The greatest expenditures would be for terraces and windstrip/windbreak on cropland and planned grazing systems on rangeland, but they are essential to maintain soil losses within tolerable levels.

The land treatment cost also includes $2,093,900 for installing rural water systems on about 3 million acres of rangeland. These rural water systems are an important element of an improved grazing system.

Wildlife Habitat Evaluation

The potential for farmland wildlife in the year 2000 will increase 15% between future without project conditions and preferred conditions; while rangeland wildlife increases (1%). The potential is the same for the preferred, NED, and EQ alternatives. The primary factor influencing the potential is the increase in cropland acreage and the decrease in rangeland acreage.

Regional Economic Impact

The preferred alternative is estimated to increase agriculture-related employment from 21,600 to more than 37,000. The estimated total impact is shown below:

	Total	Change from Future Without Project Conditions - 2000
Employment (M person-years)	37.5	15.9
Women employed (M person-years)	5.0	2.2
Minorities employed (M person-years)	2.1	0.9
Income (MM 1977 $)	527.5	223.1
Gross Regional Product (MM 1977 $)	1175.3	492.2
Total Sales (MM 1977 $)	1862.7	783.7

These impacts include direct, indirect and induced effects. The direct impacts are those of the agriculture sector itself. Indirect impacts come from the effects of the agriculture sectors on those industries that sell inputs to agriculture industry, i.e., sales of fertilizer, machinery, gas, oil, etc. And the induced impact is a result of the employees and owners of the direct and indirect impacted industries spending their income in the region, i.e., purchase of cars, houses, food, etc.

The impact on employment for women and minorities would result if the industries that have an increase in employment hire women and minorities in the same proportion as they do today. The percent of women and minorities employed is slightly smaller in the preferred alternative than present.

Impacts of Preferred Alternatives

The following factors must be considered by State and local planning groups to evaluate environmental impacts of the preferred plan.

1. Impact on Study Area - Selective impacts on the study area are discussed in detail within the environmental quality account. A major adverse effect of the preferred plan would be the increase in wind erosion by 25 percent even though there would be a decrease in water erosion by 55 percent. The larger losses expected from wind erosion would result from increasing cropland production by 26 percent. Also various land treatment measures would be required to keep soil losses within tolerable levels.

2. Relationship to Land Use Plans and Policies - Although no specific project measures are proposed for the study area, implementation of programs to conserve the natural resources would have an impact on land use plans and policies. A major vehicle for reducing soil losses will be through implementation of the "Sediment and Erosion Control Bill of 1976". Such legislation measures, along with programs carried on by local conservation districts, will play a dominant role in planning and installing land treatment measures designed to keep soil losses within tolerable limits.

3. Analysis of Alternatives - The assessment of alternatives as displayed in Chapter 5 places emphasis on development of a "planning tool" for dealing with the future political, social, economic, and environmental conditions. The results of these alternatives would be to increase agricultural production while enhancing the environmental quality of the region through conservation and improvement of the natural resources. More specifically, the preferred alternative would result in maximum net revenue while maintaining soil losses within tolerable levels. In order to achieve this, a variety of soil conserving land treatment measures would need to be installed at an estimated cost of over $39 million.

4. Short Term Uses Versus Long Run Productivity - Increased productivity of selected crops would result in conversion of rangeland and pastureland to cropland. Although overall soil losses would be reduced by utilizing a variety of conservation measures, wind erosion would increase.

5. Commitment of Resources - Installation of rural water systems and conversion of rangeland and pastureland to cropland would require the use of more energy, technology, and raw materials. These uses would be irretrievable.

Displaying Impacts of Preferred Alternative

The impacts of the preferred alternative on erosion and sediment losses; rangeland and pastureland management practices; inefficient irrigation conditions and depletion of wildlife habitat are shown in Table 6-1.

The four accounts display the beneficial and adverse effects of the preferred alternative. There is an estimated increase of $260,000,000 in net revenue from a combination of crop rotations, land use conversions, land treatment practices, management techniques, and conservation tillage practices, all selected to maximize profit. Environmental impacts include a decrease in soil losses and acres exceeding tolerable limits and an increase of conservation tillage practices. The potential for increased employment and income is an important regional development impact. Future social well-being of the region would generally be improved.

Table 6-1 - EXPECTED CHANGES IN PROBLEMS AND CONCERNS BY 2000 AND THEIR ESTIMATED IMPACT.

Problems or Concerns	Units	Present Conditions Year-1975	Expected Conditions Year-2000	With Preferred Alternative Year-2000	Effects of Preferred Alternative Year-2000
1. Erosion and Sediment					
(a) Sheet, Rill, and Wind Erosion	Avg. Ann. Tons	38,580,000	38,812,000	22,673,000	-16,139,000
1. Sediment delivered to streams	Avg. Ann. Tons	3,860,000	3,881,000	2,267,300	- 1,613,700
(b) Gully and Streambank Erosion	Avg. Ann. Tons	50,300,000	50,300,000 1/	45,270,000 2/	- 5,030,000 2/
1. Sediment delivered to streams	Avg. Ann. Tons	33,870,000	33,870,000	30,483,000	- 3,387,000
(c) Total Erosion	Avg. Ann. Tons	88,880,000	89,112,000	67,943,000	-21,169,000
1. Total Sediment delivered	Avg. Ann. Tons	37,730,000	37,751,000	32,750,300	- 5,000,700
(d) Acres Exceeding Soil Loss Limits	Acres	3,071,888	2,990,260	0	- 2,990,260
2. Improper Rangeland Management					
(a) Continuous heavy use	Acres	7,806,747	7,534,792	0	- 7,534,792
(b) Needs reseeding	Acres	1,348	64,660	0	- 64,660
3. Inadequate Water for Livestock and Rural Household Use	Acres	3,000,000	3,000,000 1/	0	- 3,000,000
4. Improper Pastureland Management	Acres	253,450	277,484	0	- 277,484
5. Inefficient Irrigation Management	Acres	60,000	60,000 1/	0	- 60,000
6. Depletion of Wildlife Habitat					
(a) Farmland Wildlife	% Developed 3/	50	57	72	+ 15
(b) Rangeland Wildlife	% Developed	62	51	52	+ 1

1/ Some changes are expected by 2000, but procedures for making projections are inadequate.

2/ Reduction in gully and streambank erosion is expected to decrease with improved rangeland management. Based on a study completed by SCS for the extreme western tier of counties, gully and streambank erosion was estimated to be reduced 10 percent through improved conservation practices.

3/ Percent developed for wildlife refers to the degree (percent) to which lands have a development potential for wildlife. The ultimate potential would be 100 percent.

PREFERRED ALTERNATIVE

NED Account

	Future Without Project Conditions	Preferred Alternative Conditions	Beneficial Effects
Gross Revenue	352,995,000	626,489,600	273,494,600
Net Revenue	205,002,700	444,582,900	239,580,200
			Adverse Effects
Costs:			
Crop Budgets 1/	132,174,500	142,292,200	10,117,700
Land Treatment 2/			
Cropland	501,500	19,917,300	19,415,800
Pastureland	2,479,100	1,890,800	(588,300) 4/
Rangeland	12,837,200	17,806,400 3/	4,969,200
Total Costs	147,992,300	181,906,700	33,914,400

1/ These production costs were based on crop budgets developed by ESCS.

2/ Land treatment costs are based on data developed by SCS.

3/ Includes an estimated cost of $2,093,900 for installation of rural water systems needed as part of the management requirements for an improved grazing system.

4/ Decrease in treatment costs on pastureland was due to decreased pastureland acreage.

PREFERRED ALTERNATIVE

Environmental Quality Account

Beneficial and Adverse Effects

1. Reduction in soil losses from water of 55 percent (16,134,204 ton) for 2000 when compared with future without project conditions.

2. Increase in soil loss from wind of 25 percent (1,461,689 ton) for 2000 when compared with future without project conditions.

3. Acres exceeding tolerable soil loss levels will be eliminated on 3 million acres.

4. Cropland will increase by 1,425,624 acres, or 26 percent, pastureland will decrease by 133,951 acres, or 29 percent, and rangeland will decrease by 1,291,673 acres, or 8 percent.

5. Conventional tillage of cropland will decrease by 1,341,166 acres, or 82 percent and conservation tillage practices will increase on 3,818,053 acres.

6. Combinations of land treatment practices including contour stripcropping, windstrip, windbreak, contouring, and terracing, will be installed on 5,641,225 acres of cropland.

7. Pastureland treated with an improved grazing system will increase by over 32,354 acres, or 70 percent, while rangeland treated with a planned grazing system will increase by 14,570,989 acres.

8. The land use factor and the quality factor for farmland wildlife both increased resulting in an increase in development potential from 57% to 72% and an acre value increase from 12.9 million to 16.3 million.

9. The land use factor for rangeland wildlife decreased, but the quality factor increased resulting in an increase in development potential from 51% to 52% and an acre value increase from 11.6 million to 11.8 million.

PREFERRED ALTERNATIVE

Regional Development Account

Beneficial and Adverse Effects

	Total	Change From Future Without Project Conditions - 2000
Employment (M person-years)	37.5	15.9
Women Employed (M person-years)	5.0	2.2
Minorities Employed (M person-years)	2.1	0.9
Income (MM 1977 $)	527.5	223.1
Gross Regional Product (MM 1977 $)	1175.3	492.2
Total Sales (MM 1977 $)	1862.7	783.7

PREFERRED ALTERNATIVE

Social Well Being Account

Beneficial and Adverse Effects

1. Stabilize the economy of the agriculture sector.

2. Increase population in the rural communities through increased employment - both on farm and in other industries in the communities.

3. Will require more services, i.e. water, utilities, schools, law enforcement, fire protection, etc., in the rural communities.

IMPLEMENTATION
OF
PREFERRED ALTERNATIVE

CHAPTER 7

Implementation of Preferred Alternative

A plan to solve problems and meet anticipated needs through USDA programs is presented in this chapter. The initiative to use these resources rests with the residents and landowners in the study area. Conservation measures to implement the plan will be installed when the individual landowners are convinced of the need and the resulting environmental and economic benefits. There is a continuing information program which informs landowners of the assistance available from USDA agencies in order that they may select the combination of programs or management systems that best meet their needs and desires. The Soil Conservation Service programs will be directed toward erosion control, moisture conservation, efficient management and proper land use.

This study report is an educational tool to inform the public of the environmental and economic advantages resulting from applying land treatment measures and improving management techniques. Conservation district supervisors will use the data to develop specific objectives for district long range program.

A. USDA Programs to Implement the Preferred Alternative

1. PL 74-46
   Land treatment is a continuing need. The USDA, through the Soil Conservation Service, Agricultural Stabilization and Conservation Service, and the Farmers Home Administration, provides technical and financial assistance to landowners and operators for the planning and application of land treatment measures.

2. PL 84-1021
   The objective of the Great Plains Conservation Program (GPCP) is to assist farmers and ranchers to carry out on a voluntary basis a plan of operations that, through cropping and grazing systems and the application of enduring soil and water conservation practices, will bring about greater stability to operating units and the area. The law provides cost-share and technical assistance during the life of a contract based on a conservation plan for the land user's entire operating unit.

3. PL 83-703
   The Resource Conservation and Development (RC&D) Program was authorized by the Food and Agriculture Act of 1962. It expands opportunities for conservation districts, local units of government, and individuals to improve their communities in multicounty areas. This program can assist them in enhancing their economic, environmental, and social well-being. The RC&D program provides technical and financial assistance to reduce erosion and control sedimentation, convert poorly suited cropland to grassland, woodland, wildlife habitat or recreational use, improve farm irrigation, and develop rural water systems.

4. PL 95-217
   The Rural Clean Water Program provides financial and technical assistance to private landowners and operators (participants) having control of rural land. The assistance is provided through long-term contracts (5 to 10 years) designed to install best management practices (BMPs) in project areas which have critical water quality problems resulting from agricultural activities. The proposed project area must be within a high priority area in an approved agricultural portion of a 208 water quality management plan. Participation in the Rural Clean Water Program (RCWP) is voluntary.

   The RCWP is designed to reduce agricultural nonpoint source pollutants and to improve water quality in rural areas to meet water quality standards or water quality goals. The objective is to be achieved in the most cost-effective manner possible in keeping with the provision of adequate supplies of food and fiber and a quality environment.

5. Farmers Home Administration Loans
   Farmers Home Administration (FmHA) furnishes farm credit for family-type farms and rural area projects. Farm ownership, farm operating, farm housing, water development, and soil conservation-type loans are all available to local landowners and operators. Watershed loans are available to assist eligible organizations in meeting their share of cost of works of improvement in connection with PL-566 watershed protection projects and RC&D projects.

6. Cooperative Federal-State-Private Forestry Programs
Existing cooperative forestry programs can be accelerated or initiated to help meet needs and solve problems on nonfederal public lands and private forest lands. These programs provide a variety of forestry projects and measures for development and protection of these forest lands. The programs are applied under the direction of the state foresters. The state agencies, private forest owners, processors, rural community planners, developers, and the Forest Service cooperate to implement the programs.

7. National Forest Programs
There are many opportunities for accelerated development to meet projected needs and solve problems on the National Forest lands.

Land treatment measures are important features of the National Forest program. Area treatment may consist of establishing range grasses, providing plant control, fertilizing when necessary, tree planting, improving timber stand, sloping and revegetating roadbanks, fencing, developing range water, controlling grazing, improving transportation facilities, improving wildlife and fish habitats, and many other activities. These measures will provide protective cover for critical and other areas, increase the infiltration and percolation rates of the soil, reduce the rate of erosion, reduce the production of sediment, and stabilize the rate of runoff. These measures will also contribute to satisfying the growing demands for forestry related goods and services.

B. Coordination of USDA Programs for Future Development.
Productive use and future development of the physical, biological, social, and economic resources of the basin are important responsibilities of local people. Wise and careful management will enhance and perpetuate the quality and usefulness of the environment, but many efforts including research, education, and land use planning are needed. Utilizing the federal, state, community, and private programs will defray costs to the individual landowners in implementing land treatment measures and management techniques.

The Soil Conservation Service, working through local soil conservation districts, provides technical assistance in farm and ranch planning, soil surveys, structural program investigations, installing conservation practices, and cost sharing through the GPCP. The Agricultural Stabilization and Conservation Service will need an expanded program of cost sharing (through ACP) for conservation practices. The Science and Education Administration-Extension, through the local county agents, will need an expanded program of adult education and leadership training, particularly for the new operators who move into the basin and are unfamiliar with local farming methods and climatic problems.

Program coordination among all the concerned federal, state, and local agencies is necessary to assure that the proposed land and water resource programs complement each other and provide for a coordinated development of the resources and economy of the region. If resource utilization is to improve, technical and financial assistance will need to be accelerated or redirected to support the concept of resource management. Initial acceptance must be with each individual; ultimate support must be through group action, either by political subdivisions or private organizations.

County committees established under law and working with state and federal agencies, should plan for efficient and optimum use of water and related land. These local organizations along with the soil conservation districts should be granted the legal authority to insure acceptable use of water and related land resources.

RESOURCE BASE

APPENDIX A

Resource Base

Location and Size

The Western South Dakota River Basins include all the area in the 23 counties in South Dakota west of the Missouri River. This 41,657 square mile area includes the following river basins: Little Missouri River, 585 square miles; Cedar River (tributary to the Cannonball River in North Dakota), 94 square miles; Grand River, 4,669 square miles; Moreau River, 5,375 square miles; Cheyenne River, 13,973 square miles; Bad River, 3,119 square miles; White River, 8,181 square miles; Ponca Creek, 404 square miles; Keya Paha River and other tributaries to the Niobrara River in Nebraska, 1,255 square miles; and the remaining area along the west side of the Missouri River, 4,002 square miles. The tributaries to the Niobrara are located in subregion 1008 and the remainder of the area is in subregion 1005.

Climate

The climate is of semiarid continental type with a large temperature contrast from summer to winter, and occasionally from day to day. Winds average about 10 miles per hour with the prevailing direction from the northwest in the winter and from the southeast in the summer. Strong winds of 50 miles per hour, or more, may occur any month but are most likely to occur with summer thunderstorms.

The average annual precipitation varies from about 14 inches in the northwest to 24 inches in the southeast and about 22 inches in the northern Black Hills. See figure A-1. About 75 percent of this precipitation occurs during the growing season, April through September. Average seasonal snowfall varies from about 24 inches in the plains area to over 100 inches in the northern Black Hills.

Mean annual temperature varies from 42.6 degrees F., at Lemmon to 48.8 degrees F., at Wood (table A-1). Temperature extremes recorded show a low of -58 degrees F., at McIntosh in February 1936 and high of 116 degrees F., at Cottonwood in 1910 and at Wood in 1936.

The length of growing season varies from about 115 to 130 days in the plains area to about 100 days at the higher elevation in the Black Hills. Average annual lake evaporation varies from 36 to 42 inches.

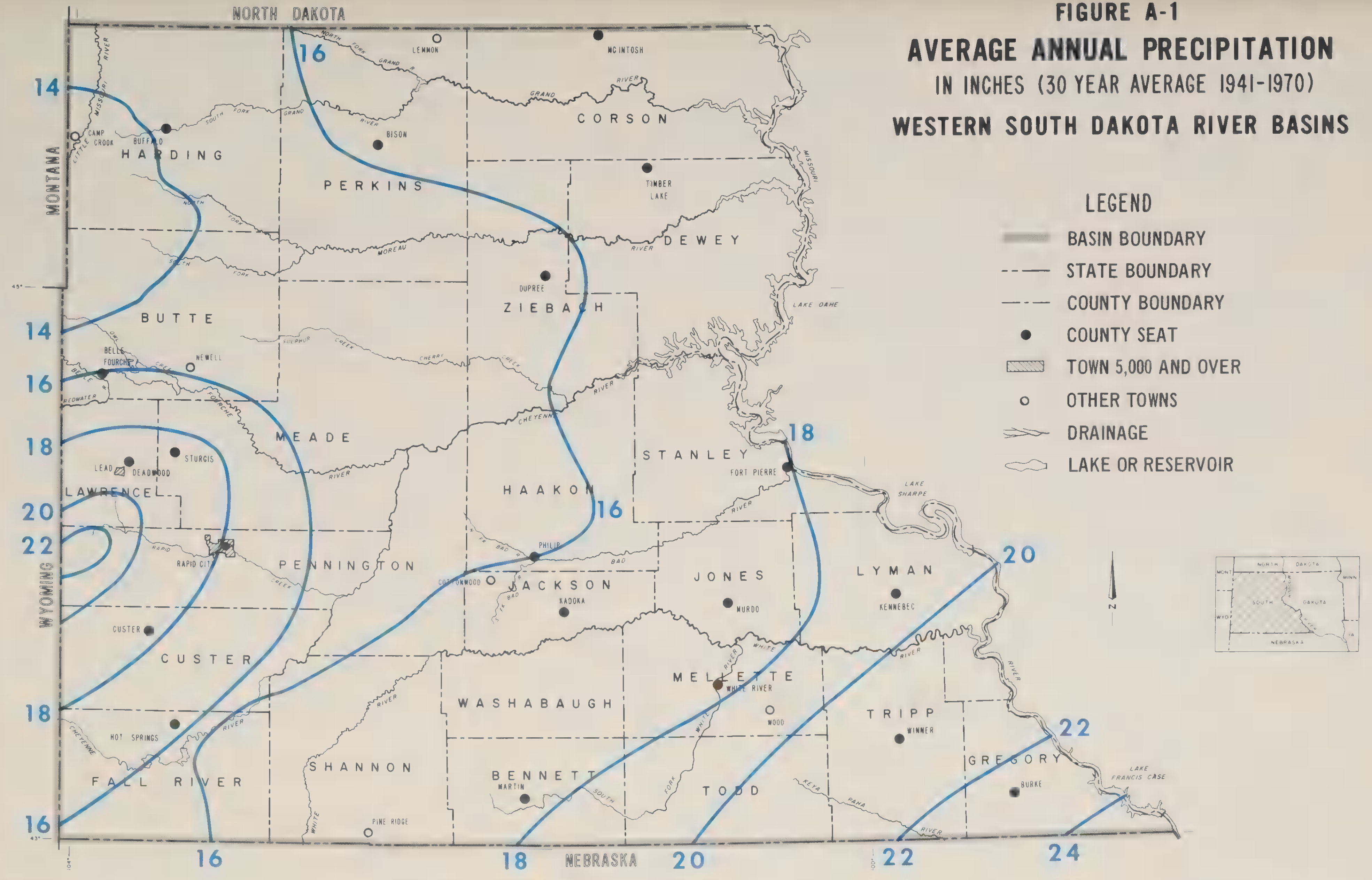
Land Resources

Land Resource Areas
The Land-Resource Areas map (Figure A-2) is an interpretative map showing geographical areas of similar climate and topography. These characteristics indicate type of agriculture that can occur within them and the types and intensities of problems that will be encountered. A more detailed description of these areas can be found in the 1967 Conservation Needs Inventory report.

Table A-1 - TEMPERATURE AND PRECIPITATION FOR SELECTED STATIONS

Recording Stations	Period of Record	TEMPERATURE (Degrees F.) Mean Annual	EXTREMES Maximum	EXTREMES Minimum	PRECIPITATION (Inches) Average Annual	EXTREMES Maximum	EXTREMES Minimum
Camp Crook	1896-1972	43.8	114	-57	13.71	24.07	4.73
Lemmon	1917-1972	42.6	115	-45	15.70	25.00	8.77
Dupree	1922-1972	45.4	114	-39	15.52	23.64	8.06
Newell	1908-1972	44.7	110	-38	15.47	28.04	6.64
Cottonwood	1910-1972	46.7	116	-42	15.22	27.62	7.13
Wood	1913-1972	48.8	116	-36	19.10	33.49	8.92
Pine Ridge	1933-1972	48.2	112	-43	16.37	27.78	9.60
Rapid City	1892-1972	47.1	107	-34	17.46	28.89	7.51
Lead	1909-1972	44.2	101	-40	25.41	42.76	12.84

FIGURE A-1
AVERAGE ANNUAL PRECIPITATION
IN INCHES (30 YEAR AVERAGE 1941-1970)
WESTERN SOUTH DAKOTA RIVER BASINS

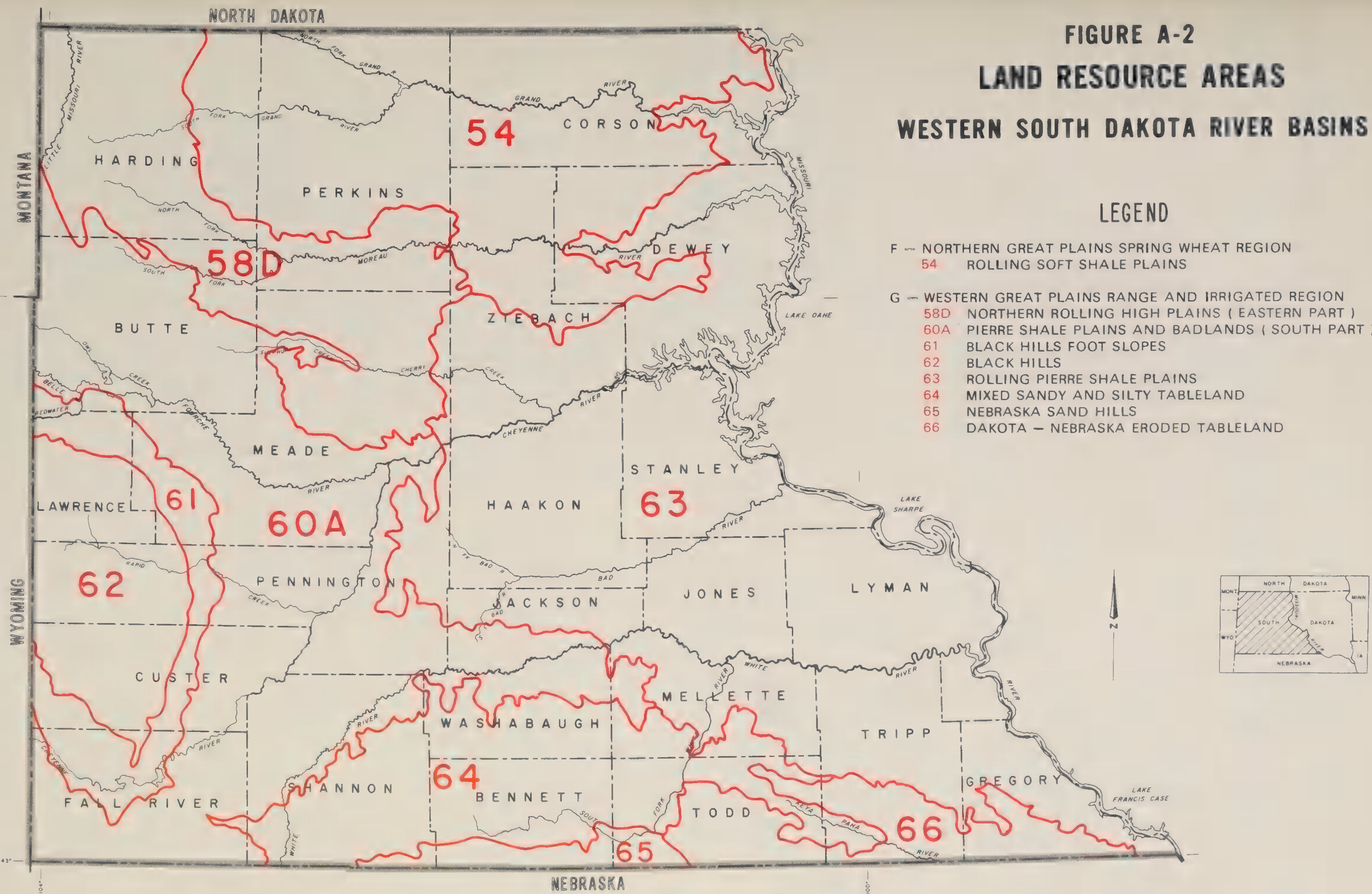


SOURCE:
FAMILY OF MAPS S.C.S DRWG. NO. 5,R-30,116 (5-8-72)
AND NATIONAL WEATHER SERVICE DATA AS ANALYZED
BY W. F. LYTLE, AG. ENG. DEPT., SDSU, BROOKINGS, S.D.
LAMBERT CONFORMAL CONIC PROJECTION

Rev. 12-18-78
5, N-36,974

USDA-SCS-LINCOLN, NEBR. 1978

FIGURE A-2
LAND RESOURCE AREAS
WESTERN SOUTH DAKOTA RIVER BASINS



LEGEND

F — NORTHERN GREAT PLAINS SPRING WHEAT REGION
- 54 ROLLING SOFT SHALE PLAINS

G — WESTERN GREAT PLAINS RANGE AND IRRIGATED REGION
- 58D NORTHERN ROLLING HIGH PLAINS (EASTERN PART)
- 60A PIERRE SHALE PLAINS AND BADLANDS (SOUTH PART)
- 61 BLACK HILLS FOOT SLOPES
- 62 BLACK HILLS
- 63 ROLLING PIERRE SHALE PLAINS
- 64 MIXED SANDY AND SILTY TABLELAND
- 65 NEBRASKA SAND HILLS
- 66 DAKOTA — NEBRASKA ERODED TABLELAND

1 / 2,280,000

SCALE 0 10 20 30 40 50 60 MILES
0 10 20 30 40 50 60 70 80 90 100 KILOMETERS

SOURCE:
FAMILY OF MAPS S.C.S. DRWG. NO. 5,R-30,116 (5-8-72)
AND INFORMATION FROM FIELD TECHNICIANS
LAMBERT CONFORMAL CONIC PROJECTION

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Physiography and Geology

A comparison of the study area physiography (figure A-3) and geology (figure A-4) reveal a close association between these physical features.

The study area lies within the Great Plains province and includes portions of three divisions: Missouri Plateau, 88 percent; Black Hills, 11 percent; and the High Plains, 1 percent. See figure A-3.

Erodible, gray-black silt and clay soils of the Pierre shale are exposed along most of the primary and secondary streams in the Missouri Plateau division. Some younger, lighter-colored silts, sands, and clay soils overlay this shale in the northern and southern portions of this area. These deposits are less consolidated and generally more erodible than the Pierre shale. The "badlands" are located in this area.

The Black Hills division is a mountainous area upthrust from the plains about the same time the Rocky Mountains were formed. Harney Peak, the highest point in the study area at an elevation of 7,242 feet, is located in this division. Outcrops of consolidated layers of limestones, shales, and sandstones alternate throughout this section.

The High Plains division is a small area located in southern Bennett, Shannon, and Todd Counties. It is locally referred to as the Sand Hills. Very little surface runoff occurs in this area.

Soil Resources

A general soils map and legend, along with a listing of the dominant soil series in each association, is shown on figure A-5. Source of the map is from a map "Soils of the Great Plains" by Andrew R. Aandahl, 1972.

Detailed soil surveys are complete for Bennett, Butte, Dewey, Lawrence, Meade (southern part), Mellette, Shannon, Stanley, Todd, Tripp, and Washabaugh Counties. Detailed information about soils can be obtained at the local office of the Soil Conservation Service. Information includes descriptions of the soils and agronomic, engineering, and other special use interpretations.

Soil Resource Groups are described in Appendix C.

Water Resources

Surface Water

Information on the amount of surface water yields was obtained from the network of streamgaging stations throughout the study area. In general, the amount of surface water runoff varies with the amount of precipitation.

For the greater portion of the study area, described as the Missouri Plateau in the physiography section, the average annual runoff varies from about 0.5 to 0.7 inch. This area includes the drainages of the Grand River, Moreau River, Cheyenne River (excluding the Black Hills), Bad River, and White River (excluding the Little White River).

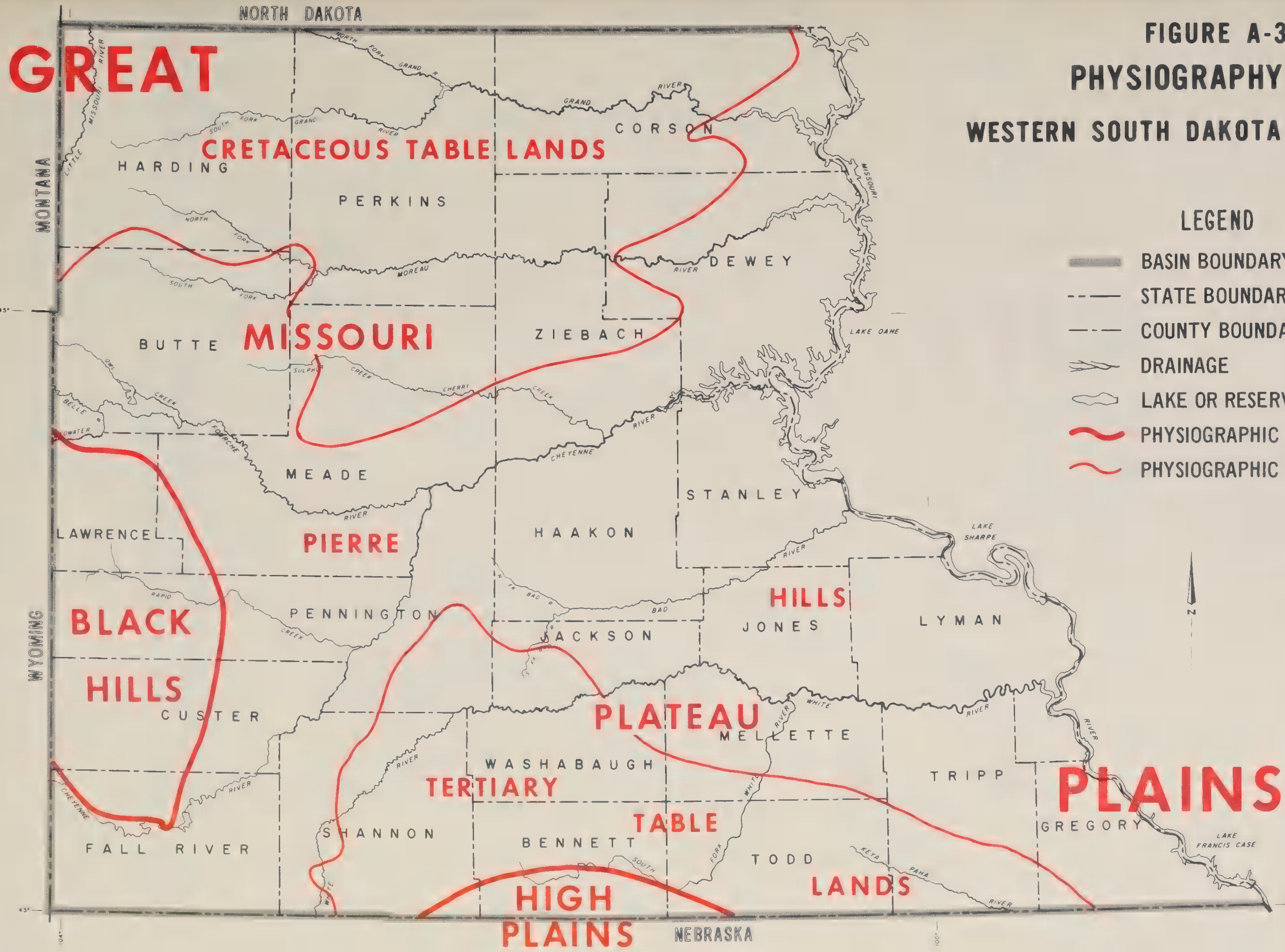
It is estimated that more than 75 percent of the annual runoff occurs during the 4-month period of March through June. See figure A-6. The high runoff in March and April is usually from snowmelt while the runoff in May and June is from rainfall. June, normally, has the most precipitation and runoff. Annual runoff may vary widely from year to year (figure A-6). Most of the streams will show periods of no flow almost every year during the fall and winter months.

For the area in the extreme southeastern portion of the study area, comprising the drainages of the Little White River, Keya Paha River, and Ponca Creek, the average annual water yield varies from 1.0 inch to 1.5 inches. The Little White River, which drains a portion of the northern fringes of the Nebraska Sandhills, is the most dependable water yielding stream. The flow is fairly uniform throughout the year and from year to year. See figures A-6 and A-7. A streamgage located near Rosebud, having a drainage area of 1,020 square miles, shows an average annual runoff of 1.51 inches with a minimum runoff of 1.15 inches for water year 1959 and a maximum of 2.06 inches for water year 1944. This fairly uniform flow throughout the year is a result of continuous ground water inflow from the sandhills area. The average annual water yields for the Keya Paha River and the Ponca Creek drainages are about 1.0 inch and 1.4 inches, respectively.

FIGURE A-3

PHYSIOGRAPHY MAP

WESTERN SOUTH DAKOTA RIVER BASINS



LEGEND

- BASIN BOUNDARY
- STATE BOUNDARY
- COUNTY BOUNDARY
- DRAINAGE
- LAKE OR RESERVOIR
- PHYSIOGRAPHIC DIVISION
- PHYSIOGRAPHIC SECTION

SOURCE:
SOUTH DAKOTA GEOLOGICAL SURVEY, FAMILY OF MAPS S.C.S. DRWG. NO. 5,R-30,116 (5-8-72) AND INFORMATION FROM FIELD TECHNICIANS.
LAMBERT CONFORMAL CONIC PROJECTION

7-12-78
5,N-36,975

USDA-SCS-LINCOLN, NEBR 1978

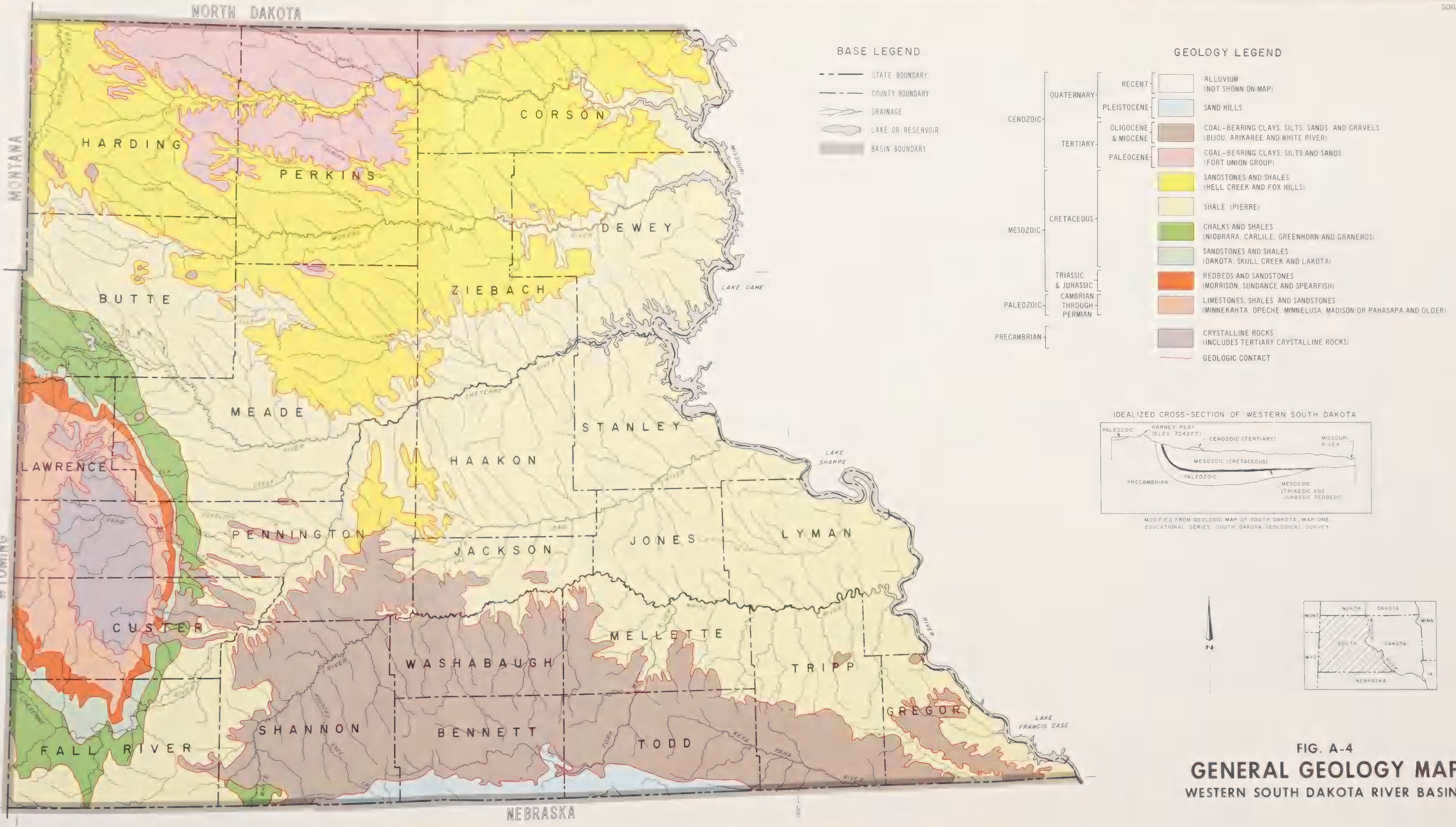


FIG. A-4
GENERAL GEOLOGY MAP
WESTERN SOUTH DAKOTA RIVER BASINS

1/1,500,000

SCALE 10 0 10 20 30 40 MILES

SOURCE
SCS DRAWING 5,R-30,116(5-72), STATE GEOLOGIC MAPS
DARTON(1951) AND PETSCH(1953), PUBLISHED SOUTH DAKOTA
GEOLOGICAL SURVEY QUADRANGLE MAPS, AND UNITED
STATES GEOLOGICAL SURVEY QUADRANGLES MAPS
LAMBERT CONFORMAL CONIC PROJECTION

REV 7-18-79
5,S-36,672

Average annual surface water yields for streams draining the Black Hills vary from 0.4 inch to 4.0 inches. This variability is due, primarily, to the amount of flow and location of springs, and to the amount of exposed Pahasapa limestone formation that the streams cross. Annual yields in some streams are highly irregular and others are fairly constant. An example is Spring Creek, with a drainage area of 199 square miles above the streamgage near Hermosa, showing a low of no runoff for water year 1961 and a high of 1.88 inches for water year 1972. Fall River, with a drainage area of 137 square miles above the streamgage at Hot Springs, shows a low of 2.11 inches for water year 1970 and a high of 3.30 inches for water year 1938. See figure A-6.

A representative sample of surface water yields for various rivers and streams is shown in table A-2.

The amount of surface water stored in the Missouri River reservoirs is shown in table A-3. The Missouri River forms the eastern boundary of the study area.

Table A-2 - SURFACE WATER RUNOFF BY WATER YEAR

Streamgage and Location	Period of Record	Drainage Area Sq. Mi.	Average Annual Runoff Inches	Estimated Annual Runoff Inches 50% Chance	80% Chance	90% Chance	Maximum Annual Runoff Inches	Year	Minimum Annual Runoff Inches	Year
Grand River at Little Eagle	1929-1971	5,370	0.68	0.48	0.23	0.15	2.59	1950	0.06	1955
Moreau River near White Horse	1929-1971	4,880	0.68	0.48	0.19	0.12	2.48	1952	0.049	1955
Bad River at Ft. Pierre	1929-1971	3,107	0.69	0.45	0.23	0.16	3.30	1952	0.075	1959
Medicine Creek at Kennebec	1955-1971	465	0.48	0.26	0.077	0.043	2.08	1960	0	1959
White River near Oacoma	1929-1971	10,200	0.73	0.63	0.39	0.30	1.67	1962	0.20	1934
Little White River near Rosebud	1944-1971	1,020	1.51	1.48	1.32	1.25	2.06	1944	1.15	1959
Keya Paha River at Wewela	1948-1971	1,070	0.96	0.81	0.61	0.56	2.22	1962	0.53	1948
Ponca Creek near Naper	1961-1971	373	1.08	0.59	0.31	0.23	5.62	1962	0.26	1961
Fall River at Hot Springs	1938-1972	137	2.59	2.56	2.33	2.20	3.30	1938	2.11	1970
Spring Creek near Hermosa	1950-1972	199	0.43	0.12	0.012	0.004	1.88	1972	0	1961
Castle Creek near Hill City	1949-1972	83	1.63	1.55	1.21	1.08	2.73	1965	0.84	1961

Continued

Table A-2 - SURFACE WATER RUNOFF BY WATER YEAR

Streamgage and Location	Period of Record	Drainage Area Sq. Mi.	Average Annual Runoff Inches	Estimated Annual Runoff Inches 50% Chance	80% Chance	90% Chance	Maximum Annual Runoff Inches	Year	Minimum Annual Runoff Inches	Year
Rapid Creek at Canyon Lake	1947-1972	371	1.47	1.25	0.81	0.63	3.80	1965	0.54	1958
Cherry Creek near Plainview	1946-1972	1,190	0.56	0.38	0.09	0.03	2.20	1952	0	1961
Cheyenne River near Plainview	1951-1972	21,600	0.40	0.34	0.18	0.14	0.90	1962	0.06	1961
Spearfish Creek at Spearfish	1947-1973	168	4.16	3.95	3.12	2.75	6.90	1965	2.20	1961
Belle Fourche River near Elm Springs	1935-1974	7,210	0.66	0.56	0.26	0.16	1.65	1946	0.05	1961
Cheyenne River near Hot Springs	1944-1972	8,710	0.22	0.18	0.11	0.08	0.71	1962	0.05	1961

Table A-3 - MISSOURI RIVER RESERVOIRS 1/

Purpose	Oahe Reservoir	Lake Sharpe	Lake Francis Case
	Storage (Acre-Feet)		
1. Flood Control	1,100,000	175,000	1,000,000
2. Annual flood control and multiuse	3,200,000	None	1,300,000
3. Carryover multiuse	13,800,000	260,000	2,200,000
4. Inactive	5,500,000	1,465,000	1,200,000
Total Storage	23,600,000	1,900,000	5,700,000

1/ Corps of Engineers, U.S. Army; compiled by Missouri River Division, July 1969.

SOIL LEGEND AND EXPLANATION

THE LEGEND IS BASED UPON THE SOIL CLASSIFICATION SYSTEM ADOPTED BY THE NATIONAL COOPERATIVE SOIL SURVEY, JANUARY 1965. SOIL TEMPERATURE AND SOIL MOISTURE ARE IMPORTANT CHARACTERISTICS USED IN THE SYSTEM. PARENT MATERIALS AND GENERAL LAND USE ARE USED IN THE GROUPINGS. MAPPING UNITS (AREAS SHOWN ON THE SOIL MAP) ARE FURTHER DEFINED ON THE BASES OF GREAT GROUPS, SLOPE GRADIENTS, AND PARTICLE-SIZE CLASSES. OTHER PROPERTIES SUCH AS DEPTH TO BEDROCK IS USED WHERE IMPORTANT. IF ONE GREAT GROUP INCLUDES MORE THAN 70 PERCENT OF AN AREA, ONLY THAT ONE IS USED. IF TWO GREAT GROUPS INCLUDE MORE THAN 70 PERCENT, ONLY TWO ARE USED. IF THREE OR MORE GREAT GROUPS ARE NEEDED TO INCLUDE MORE THAN 70 PERCENT, ONLY THREE GREAT GROUPS ARE USED. A MISCELLANEOUS LAND TYPE - ROCK LAND - IS USED WITH GREAT GROUPS OF MAPPING UNITS WHICH INCLUDE PORTIONS DOMINATED BY ROCKS. BADLANDS WITH AREAS OF BARREN SOFT SHALES ARE AN EXAMPLE. THE SLOPE RANGE WHICH INCLUDES MORE THAN 70 PERCENT OF THE AREA OF A MAPPING UNIT IS GIVEN USING ONE OR MORE OF THE FOLLOWING TERMS: LEVEL, 0-3 PERCENT SLOPE, UNDULATING, 3-8 PERCENT SLOPE, ROLLING, 8-16 PERCENT SLOPE, HILLY, 16-30 PERCENT SLOPE, STEEP, MORE THAN 30 PERCENT SLOPE. AS AN EXAMPLE "LEVEL-UNDULATING" MEANS THAT MORE THAN 70 PERCENT OF THE AREA HAS SLOPE GRADIENTS OF 0-8 PERCENT. SOILS IN WESTERN SOUTH DAKOTA HAVE BEEN GROUPED INTO SIX GROUPS WITH DOMINANT SOILS AS LISTED BELOW:

DEEP SOILS FORMED IN LOESS

1 NEARLY LEVEL TO ROLLING SILTY AND LOAMY SOILS FORMED IN LOESS AND RESIDUUM FROM SANDSTONE. ARGIUSTOLLS (KEITH, RICHFIELD, AND ROSEBUD) ARE DOMINANT. LESS EXTENSIVE ARE HAPLUSTOLLS (OGLALA AND ULYSSES), AND TORRIORTHENTS (CANYON AND COLBY).

SOILS FORMED MAINLY IN RESIDUM FROM CLAYEY OR SILTY SHALES ON UPLANDS

2 DEEP AND MODERATELY DEEP, NEARLY LEVEL TO ROLLING, CLAYEY SOILS. ARGIUSTOLLS (MILLBORO AND BOYD) AND USTOCHREPTS (LAKOMA) ARE DOMINANT. MINOR SOILS INCLUDE, OKATON, OPAL, RELIANCE, AND SANSARC.

3 DEEP AND MODERATELY DEEP, NEARLY LEVEL TO ROLLING, CLAYEY SOILS. HAPLUSTOLLS (OPAL AND PROMISE) ARE DOMINANT. MINOR SOILS INCLUDE KOLLS AND SANSARC.

4 MAINLY DEEP AND MODERATELY DEEP, UNDULATING TO STEEP CLAYEY SOILS. CLAYEY HAPLUSTOLLS (BOYD) AND ARGIUSTOLLS (RELIANCE) ARE DOMINANT. LESS EXTENSIVE SOILS INCLUDE ANSELMO, LAKOMA, AND OKATON.

5 MODERATELY DEEP AND SHALLOW, UNDULATING TO STEEP, CLAYEY SOILS. USTORTHENTS (SANSARC AND OKATON) AND HAPLUSTOLLS (OPAL AND PROMISE) ARE DOMINANT. MINOR SOILS INCLUDE CAMBORTHIDS (CHANTIER AND SWANBOY).

6 DEEP TO SHALLOW, UNDULATING TO HILLY, CLAYEY AND LOAMY SOILS. ARGIUSTOLLS (SATANTA AND NUNN), SHALLOW TORRIORTHENTS (SAMSIL AND LISMAS), AND CAMBORTHIDS (PIERRE AND SWANBOY) ARE DOMINANT. MINOR SOILS INCLUDE MANTER, KADOKA, AND EPPING.

7 MODERATELY DEEP AND DEEP, UNDULATING TO ROLLING CLAYEY AND LOAMY SOILS. CLAYEY CAMBORTHIDS (PIERRE AND KYLE) AND LOAMY ARGIBOROLLS (RALPH) ARE DOMINANT. MINOR SOILS INCLUDE REGENT, RHAME, TWILIGHT, AND ABSHER.

8 DEEP TO SHALLOW, UNDULATING TO HILLY, CLAYEY SOILS. CAMBORTHIDS (PIERRE AND KYLE) AND TORRIORTHENTS (LISMAS AND SAMSIL) ARE DOMINANT.

SOILS FORMED IN MIXED SANDY AND LOAMY MATERIALS, MODIFIED BY WIND AND WATER, AND RESIDUUM FROM SANDSTONE, SILTSTONE, AND SHALE ON UPLANDS

9 MODERATELY DEEP AND SHALLOW, NEARLY LEVEL TO ROLLING, LOAMY AND CLAYEY SOILS. LOAMY ARGIBOROLLS (MORTON AND REEDER), NATRIBOROLLS (RHOADES AND BELFIELD), AND SHALLOW USTORTHENTS (CABBA) ARE DOMINANT.

10 MODERATELY DEEP AND SHALLOW, NEARLY LEVEL TO ROLLING LOAMY SOILS. ARGIBOROLLS (MORTON AND REEDER), HAPLOBOROLLS (AMOR), AND SHALLOW USTORTHENTS (CABBA AND WAYDEN) ARE DOMINANT. MINOR SOILS INCLUDE MOREAU, GRAIL AND LINTON.

11 MODERATELY DEEP AND SHALLOW, NEARLY LEVEL TO ROLLING, LOAMY TO SANDY SOILS. HAPLOBOROLLS (VEBAR AND AMOR), ARGIBOROLLS (REEDER AND MORTON), AND SHALLOW USTIPSAMMENTS ARE DOMINANT. MINOR SOILS INCLUDE TALLY, TELFER, AND PARSHALL.

12 MODERATELY DEEP AND SHALLOW, UNDULATING TO STEEP LOAMY SOILS. USTORTHENTS (CABBA, WAYDEN) AND ARGIBOROLLS (MORTON) ARE DOMINANT. MINOR SOILS INCLUDE REEDER AND LINTON.

13 NEARLY LEVEL CLAYEY SOILS WITH CLAYPAN SUBSOILS. ABSHER SOILS ARE DOMINANT. MINOR SOILS INCLUDE, MARMARTH AND TWILIGHT.

14 CAMBORTHIDS-NATRARGIDS, SHALLOW, UNDULATING TO HILLY SOILS AND SOILS WITH CLAYPAN SUBSOILS. TORRIORTHENTS (CABBART AND SCROGGIN), CAMBORTHIDS (TWILIGHT), NATRARGIDS (ABSHER), AND NATRIBOROLLS (EKALAKA AND SORUM) ARE DOMINANT. MINOR SOILS INCLUDE RHAME AND ZEONA.

15 DEEP TO SHALLOW, NEARLY LEVEL TO HILLY, LOAMY TO SANDY SOILS. HAPLUSTOLLS (ANSELMO, VETAL, AND RONSON), ARGIUSTOLLS (HOLT AND TUTHILL), AND USTORTHENTS (TASSEL) ARE DOMINANT. MINOR SOILS INCLUDE CANYON, ELSMERE, DUNDAY, AND VALENTINE).

16 DEEP TO SHALLOW, UNDULATING TO HILLY SILTY SOILS. ARGIUSTOLLS (KADOKA AND KEITH) AND TORRIORTHENTS (KEOTA AND EPPING) ARE DOMINANT. MINOR SOILS INCLUDE RICHFIELD, HUGGINS, CANYON, WANBLEE AND WORTMAN.

17 DEEP TO SHALLOW, UNDULATING TO HILLY, LOAMY TO SANDY SOILS. HAPLUSTOLLS (OGLALA) AND TORRIORTHENTS (TASSEL AND CANYON) ARE DOMINANT. MINOR SOILS INCLUDE KEITH, ULYSSES, AND COLBY.

18 DEEP TO SHALLOW, ROLLING TO STEEP, SILTY TO CLAYEY SOILS. CLAYEY TORRIORTHENTS (GRUMMIT AND MIDWAY) AND SILTY AND LOAMY TORRIORTHENTS (NEVEE, SPEARFISH, MINNEQUA, ENNING, BUTCHE, CANYON, AND COLBY) ARE DOMINANT.

SOILS OF THE SANDHILLS

19 DEEP, UNDULATING TO ROLLING SANDY SOILS. USTIPSAMMENTS (VALENTINE) IS DOMINANT. MINOR SOILS INCLUDE DUNDAY AND ELSMERE.

SOILS OF THE BLACK HILLS

20 DEEP, ROLLING TO STEEP, LOAMY SOILS. EUTROBORALFS (BUSKA AND CITADEL) ARE DOMINANT. MINOR SOILS INCLUDE EUTHROCHREPTS (HISEGA AND VANOCKER), LITHIC HAPLOBOROLLS (PAUNSAUGUNT), AND CRYOBORALFS (STOVHO).

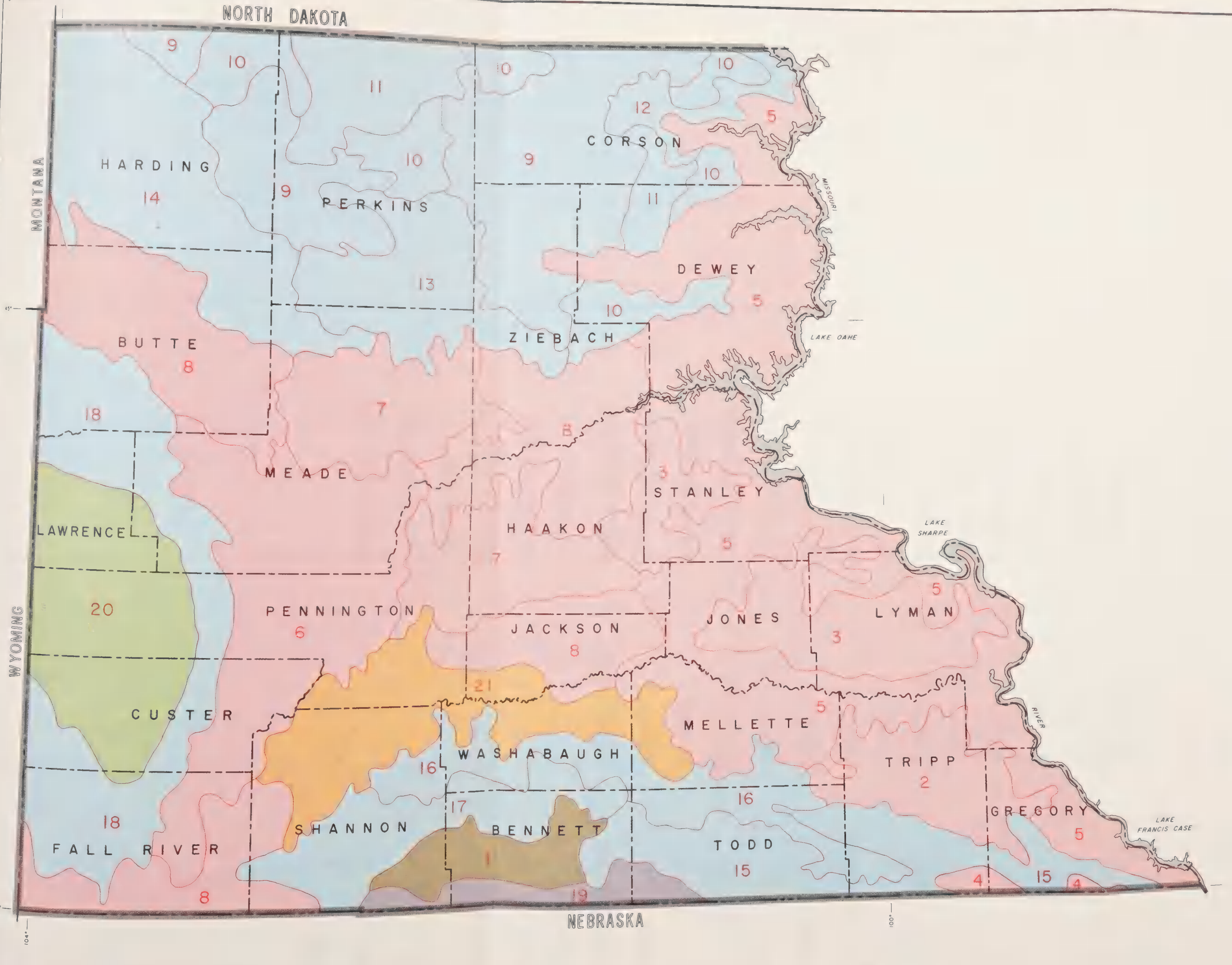
SOILS OF THE BADLANDS

21 GEOLOGICALLY ERODED BADLANDS FROM SOFT SILTY TO CLAYEY GEOLOGIC FORMATIONS. RELIEF RANGES FROM ALMOST VERTICAL WALLS TO NEARLY LEVEL ON MESAS AND IN BASINS. INCLUDES SOME GRASSED AREAS. ARGIUSTOLLS (KADOKA, KEITH, AND RICHFIELD) ARE IMPORTANT SOILS ON TABLELANDS AND MESAS. CLAYEY CAMBORTHIDS (PIERRE AND SWANBOY) AND SHALLOW TORRIORTHENTS (SAMSIL AND EPPING) ARE IMPORTANT SOILS IN THE ERODED BADLANDS AREAS.

USDA-SCS-LINCOLN, NEBR. 1978

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



LEGEND

- STATE BOUNDARY
- COUNTY BOUNDARY
- BASIN BOUNDARY

USE OF SOIL MAP

WISE DECISIONS OF THE USE OF LAND REQUIRE FULL USE OF SOILS INFORMATION. THIS MAP IS USEFUL FOR GENERAL PLANNING AND EDUCATION. SPECIFIC DECISIONS REQUIRE THE USE OF MAPS WHICH SHOW MORE DETAIL SUCH AS DETAILED SOIL MAPS. DECISIONS, SUCH AS LOCATION AND CONSTRUCTION OF BUILDINGS, DAMS, AND HIGHWAYS, REQUIRE ON-SITE INVESTIGATIONS.

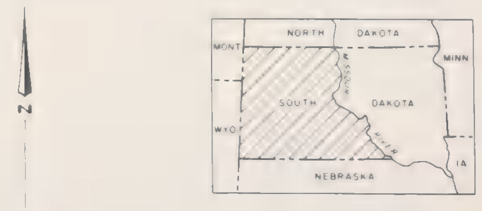


FIG. A-5

GENERAL SOIL MAP

WESTERN SOUTH DAKOTA RIVER BASINS

1/1,500,000

SCALE 10 0 10 20 30 40 MILES

SOURCE:
MODIFIED FROM "SOILS OF THE GREAT PLAINS" MAP BY ANDREW R. AANDAHL (1972). SCS DRAWING 5,R-30,116(5-72) AND INFORMATION FROM FIELD TECHNICIANS.
LAMBERT CONFORMAL CONIC PROJECTION

USDA-SCS-LINCOLN, NEBR. 1978

3-16-78
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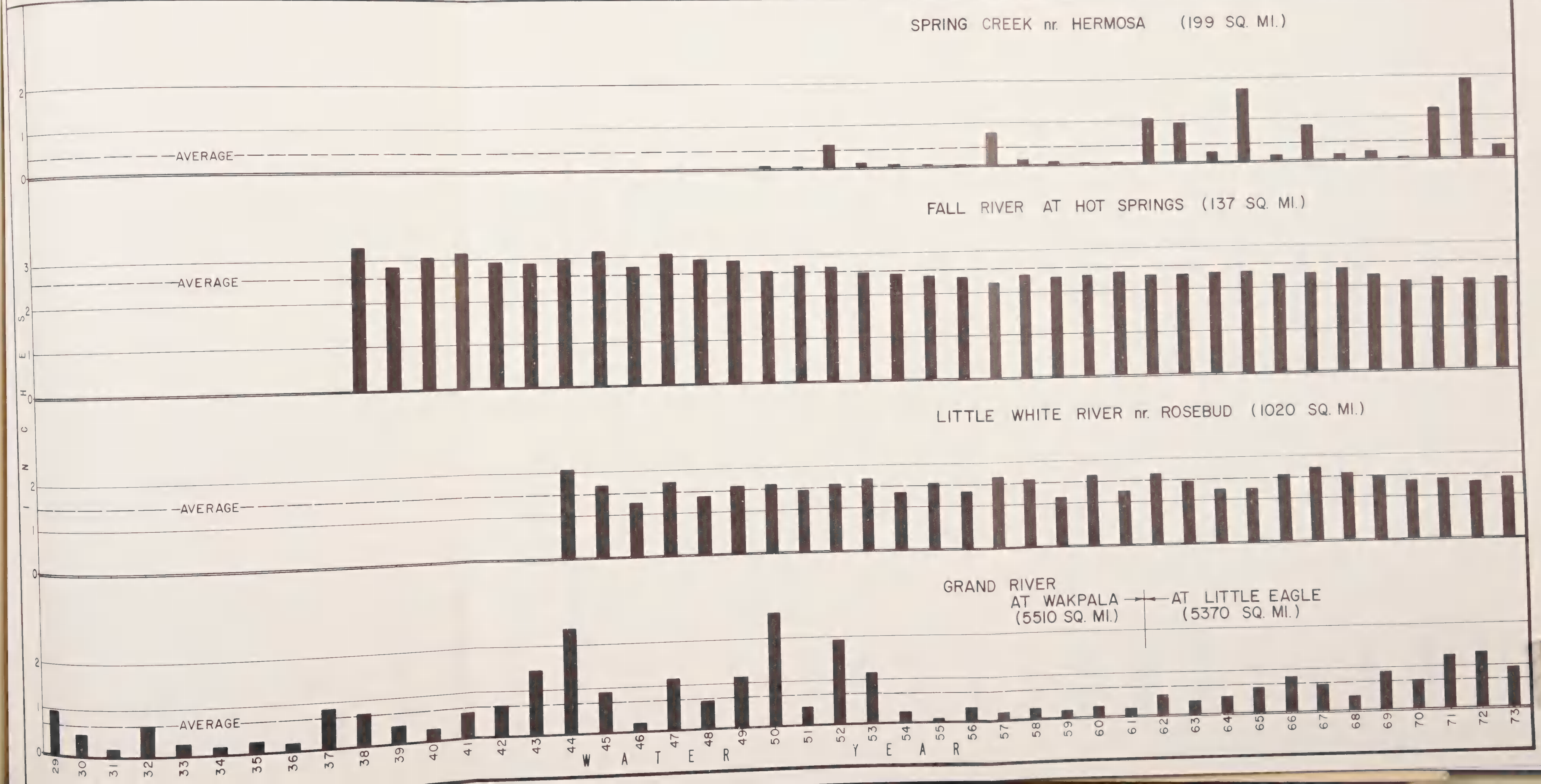
WESTERN SOUTH DAKOTA RIVER BASINS

TOTAL ANNUAL RUNOFF

FIGURE A-6



RIVER BASI

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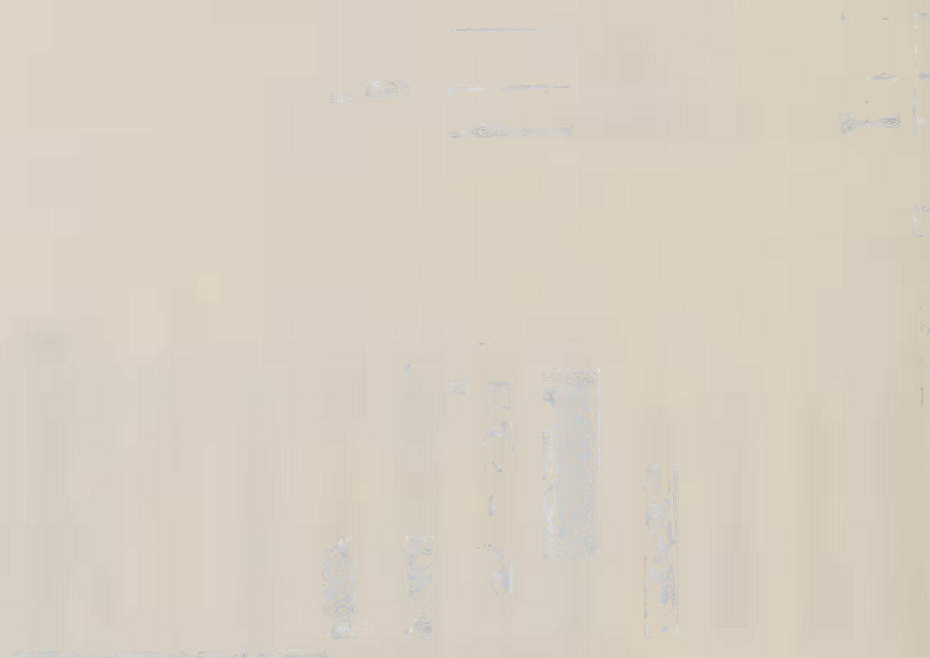
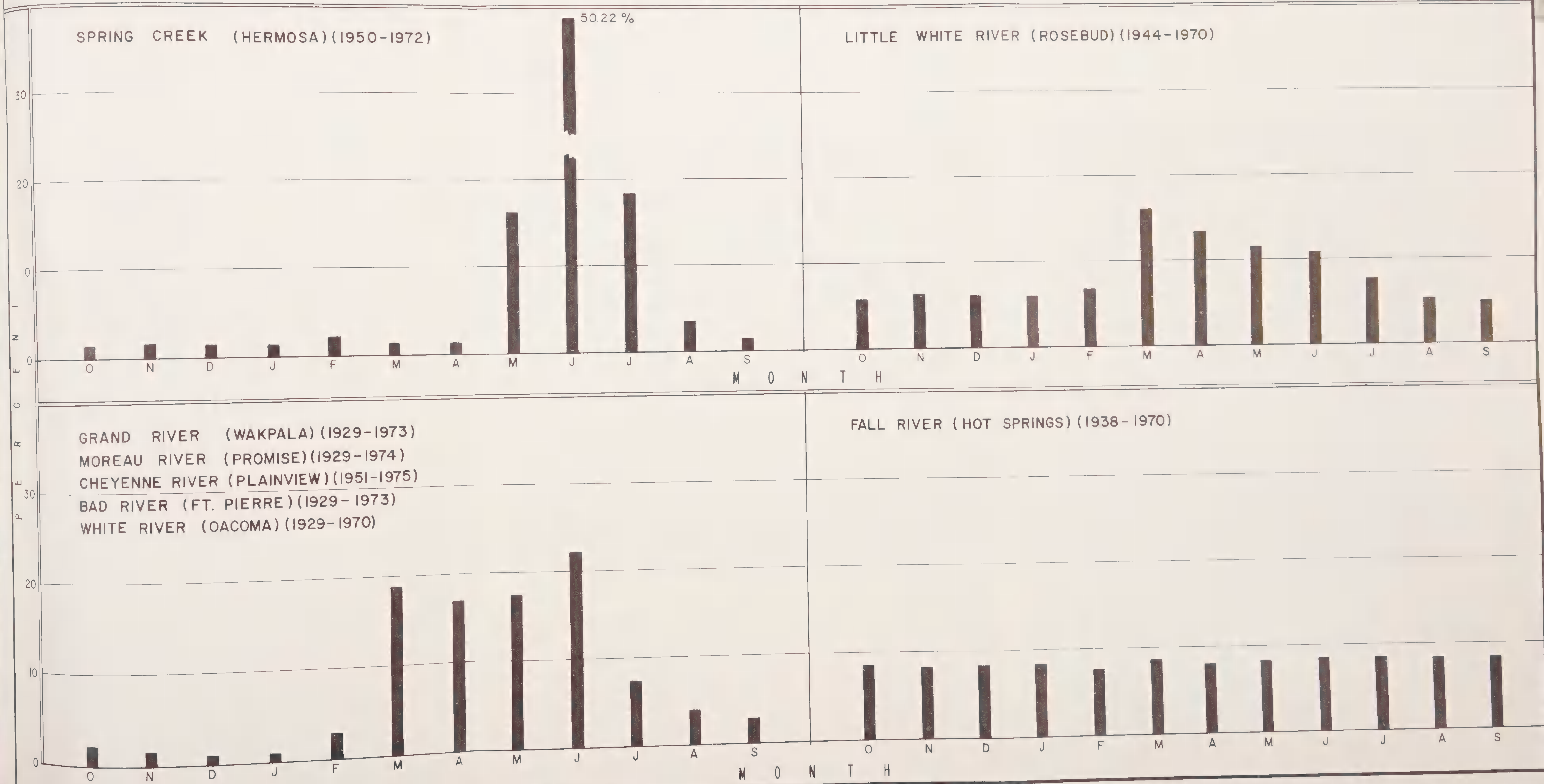


WESTERN SOUTH DAKOTA RIVER BASINS

SEASONAL DISTRIBUTION - MEAN ANNUAL RUNOFF

FIGURE A-7



Ground Water

Table A-4 lists aquifers in the study area and indicates their potential for future development. The Arikaree sands are a shallow aquifer from 0 to 500 feet below the land surface in the southern third of the study area. Hell Creek and Fox Hills in the northern third of the area are also shallow aquifers, 0 to 800 feet below the land surface.

Deeper ground water aquifers are exposed in the Black Hills and generally underlie all the rest of the study area. The first sandstone encountered below the Pierre shale is the upper part of the Dakota sandstone. Depth to this aquifer is variable ranging from 1,000 to 3,500 feet. It is absent beneath all of the Grand and most of the Moreau River basins. It is also absent beneath Custer and Fall River Counties.

The Dakota may be an overdeveloped aquifer. Water levels in wells in the aquifer have dropped over the years. Loss of this artesian head has reached 550 feet locally and some wells that flowed in the past require pumping today.

The Inyan Kara and Sundance sands lie below shales underlying the Dakota sands throughout the study area. Water from these three aquifers is under high artesian pressure and flowing wells are common. High temperature water is also common from the Inyan Kara and Sundance, and sometimes the Dakota, in the east-central portion of the study area. The two deeper sands are from 1,500 to 4,000 feet below the land surface.

The deepest aquifers, the Minnelusa sandstone and the Pahasapa or Madison limestone, also yield flowing wells. Both these aquifers are absent beneath Lyman County, while the Madison is also missing in Tripp, Gregory, and Bennett Counties, as well as in most of Shannon and Todd Counties. The thickest major aquifers in the study area range in depth from 2,000 to 6,000 feet and offer the greatest potential for development.

Small quantities of ground water are available from minor sources. These are primarily Niobrara chalk, Greenhorn limestone, and the alluvium in river and creek valleys.

Table A-4 - GROUND WATER AQUIFERS IN WESTERN SOUTH DAKOTA 1/

Aquifer (from shallowest to deepest)	Estimated Extent (mi.)	Maximum Thickness (ft.)	Potential as Aquifer	State of Development	Salinity of Water Index
Arikaree Group	5,000	600	3	1	1-2
Hell Creek	9,000	400	3	3	2-5
Fox Hills	13,000	400	3	3	1-5
Dakota	30,000(+)	460	5	4	3-5
Inyan Kara	30,000(+)	700	3	1-2	3-5
Sundance	30,000(+)	740	3	1	3-5
Minnelusa	30,000(+)	1,400	4	1	1-5
Madison	30,000(+)	1,850	5	0-1	1-5

Potential as Aquifer
- 0 = almost no potential
- 5 = high potential

State of Development
- 0 = virtually undeveloped
- 1-3 = increasingly greater withdrawal
- 4 = withdrawal just under safe yield
- 5 = withdrawal beyond safe yield

Salinity of Water Index
- 1 = 0-500 milligrams of dissolved salts in one liter of water
- 2 = 500-1,000
- 3 = 1,000-2,000
- 4 = 2,000-3,000
- 5 = 3,000 or more

1/ From U.S. Dept. of Interior (1975) Mineral and Water Resources of South Dakota, U.S. Govt. Printing Office, Washington D.C.

Water Quality

The quality of surface water depends on the material that is dissolved and suspended in it. The concentrations and characteristics of both the dissolved salts or solids and the sediment in the water are influenced by such factors as climate, amount and variability of streamflow, geology, topography, and water management practices.

The dissolved-solids content of water from the streams in the study area varies inversely with water discharge. During floods, the water may contain less than 200 milligrams per litre (mg/l) but during periods of low flow, water from most of the major streams may contain more than 2,000 mg/l. The prevailing ranges of dissolved-solids content of water from the major streams is shown on figure A-8. The predominate chemical constituents found in the water of the major streams are calcium, magnesium, sodium, and potassium. Their locations and concentrations are shown in figure A-8.

Suspended sediment concentrations and discharges vary widely in the streams depending on the nature and source of water to the streams. Discharge-weighted sediment concentrations for major streams in the study area range from about 500 mg/l in parts of the Black Hills and in the sandhills area along the Nebraska border to 70,000 mg/l in parts of the White River and Bad River Basins. As runoff or discharge increases in a river basin, sediment concentrations also increase. Over 90 percent of the suspended sediment measured in the five major river basins is carried by the runoff occurring during four months of the year (March-June). Fifty percent or more of the sediment concentrations leaving small watersheds are due to one or two major storms which occur in the watershed.

Ground water quality is highly variable in different aquifers and also within the same aquifer. Some sample chemical analyses of ground water are shown in table A-5. Generally, the higher the amount of dissolved solids in the water, the lower the quality will be.

Table A-4 lists the salinity index of some ground water aquifers. This index is a measure of the amounts of dissolved solids in water in mg/l. Water acceptable for human consumption should not have a salinity index greater than 2. The only aquifer that meets this criteria is the Arikaree group.

Water suitable for irrigation and most industrial uses should not have a salinity index greater than 3. Most of the remaining aquifers are in this category.

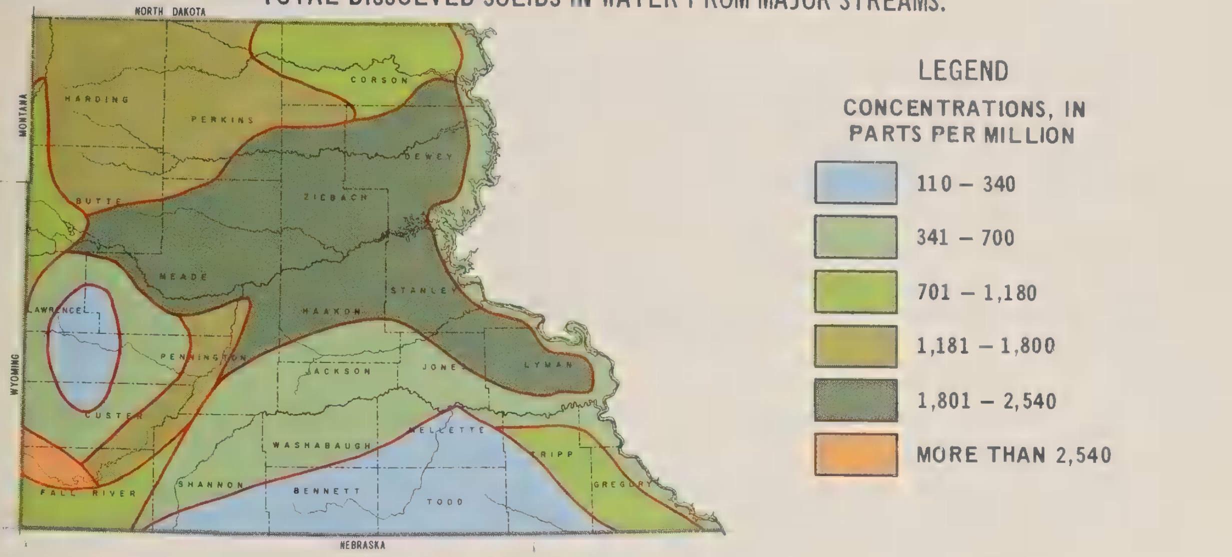
Table A-5 - REPRESENTATIVE ANALYSES OF MILLIGRAMS OF DISSOLVED SALTS IN ONE LITER OF WATER

Aquifer	Location 1/	Iron (Fe)	Calcium (Ca)	Magne-sium(Mg)	Sodium (Na)	Potassium (K)	Bicarbon-ates(HCO)	Sulfate (SO)	Chloride (Cl)	Total Solids
Arikaree Group	Shannon County	0.12	124	58	17	12	205	201	109	---
	City of Winner 2/	0.2	69	3	5	---	---	30	0	290
Hell Creek	Corson County	0.03	8.2	1.5	380	2.5	826	200	4.9	---
	Ziebach County	0.05	8.4	0.5	490	1.7	603	630	15	---
Fox Hills	Meade County	0.74	130	27	1,100	8	610	2,000	180	---
	Ziebach County	0.03	62	6.8	34	1.7	267	26	11	---
Dakota	City of Hayes 3/	---	11.2	2.0	1,865	---	---	4.5	2,014	4,227
	Haakon County	0.07	2.6	0.4	820	3.2	1,730	7.3	250	---
	Ziebach County	0.03	8.0	2.7	1,800	7.5	1,500	19.0	1,900	---
Inyan Kara	City of Wall 4/	0.1	2	0	238	2.2	347	199	12	669
	Jackson County	0.06	57	11	500	12.0	220	990	68	---
	Ziebach County	0.28	7.3	1.6	1,400	5.8	1,430	1,100	570	---
Sundance	Ziebach County	6.8	700	130	1,700	6.6	268	2,600	2,300	---
	Stanley County	0.28	178	46	330	37	222	1,120	70	---
Minnelusa	Lawrence County	0.05	80	31	2.5	2.1	250	119	0.6	---
	Jackson County	1.30	11	1.1	660	10	838	638	73	---
Madison	Ellsworth AFB 5/	0.2	73	29	6	---	---	134	4	393
	City of Eagle Butte 5/	1.4	373	102	97	---	---	1,281	71	2,263
	Perkins County 5/	---	3,400	790	22,040	---	---	2,350	40,320	69,340

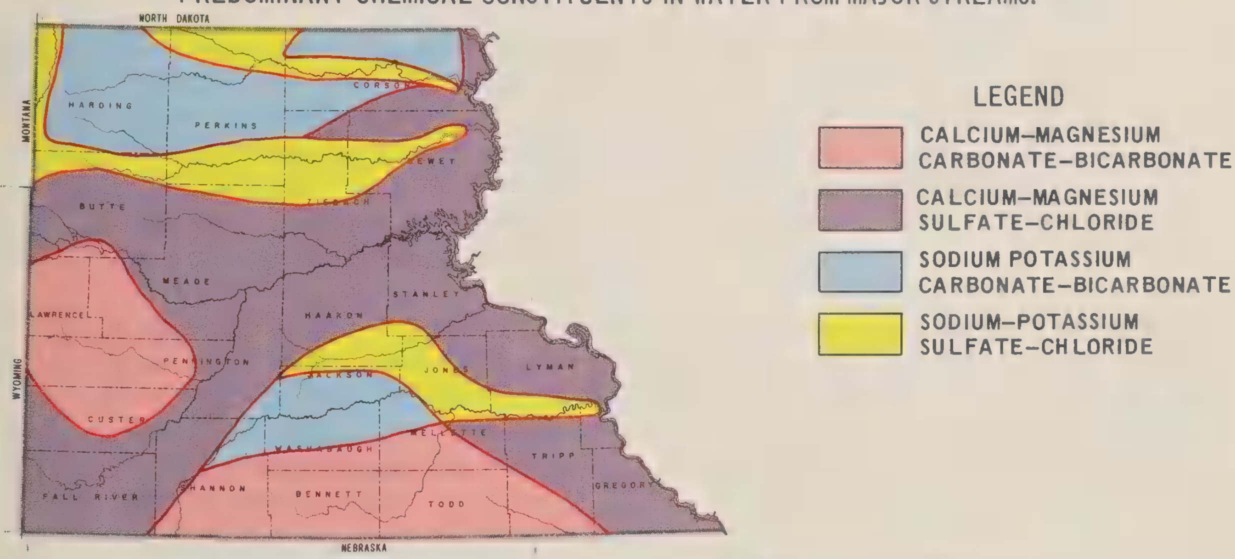
1/ Unless otherwise noted, from U.S. Geological Survey, Mineral and Water Resources of South Dakota (1975).
2/ South Dakota Geological Survey, Special Report 36 (1966).
3/ South Dakota Geological Survey, Report of Investigations No. 104 (1971).
4/ South Dakota Department of Environmental Protection, Public Water Supply, (March 1976).
5/ South Dakota Geological Survey, Report of Investigations No. 104 (1971).

FIGURE A-8
WATER QUALITY CHARACTERISTICS OF MAJOR STREAMS WESTERN SOUTH DAKOTA RIVER BASINS

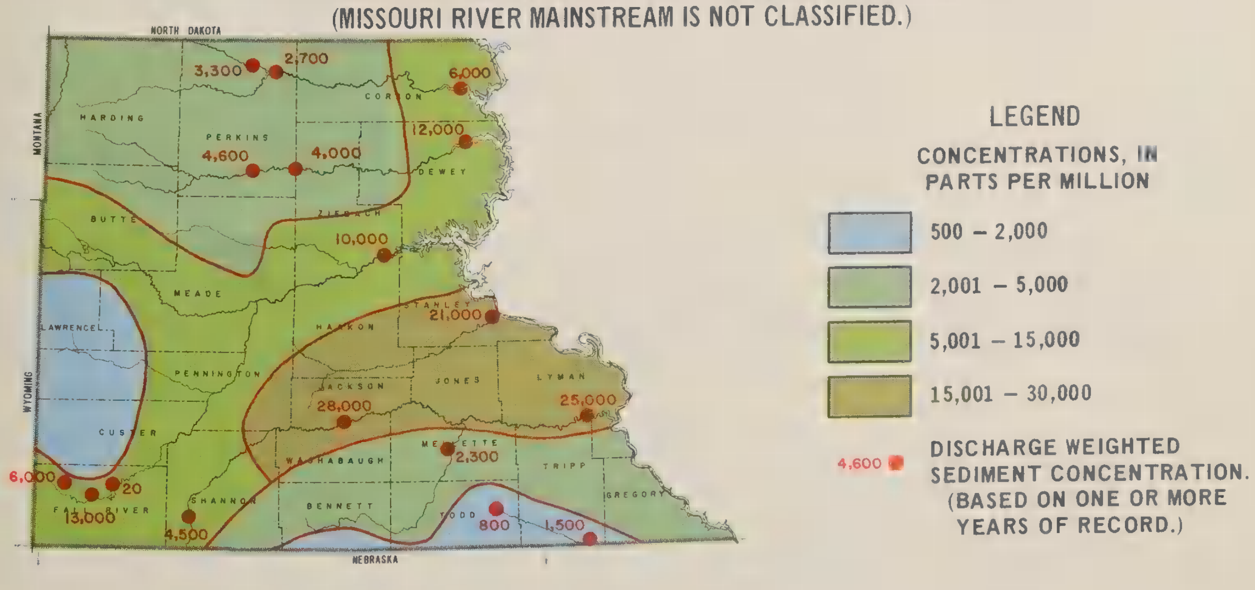
TOTAL DISSOLVED SOLIDS IN WATER FROM MAJOR STREAMS.



PREDOMINANT CHEMICAL CONSTITUENTS IN WATER FROM MAJOR STREAMS.



SUSPENDED-SEDIMENT CONCENTRATION IN MAJOR STREAMS. (MISSOURI RIVER MAINSTREAM IS NOT CLASSIFIED.)



SOURCE:
MINERAL AND WATER RESOURCES OF SOUTH DAKOTA (U.S.G.S 1975), FAMILY OF MAPS S.C.S. DRWG. 5,R-30,116 (5-8-72) AND INFORMATION FROM FIELD TECHNICIANS.
LAMBERT CONFORMAL CONIC PROJECTION

7-10-78
5,N-36,973

Land Use and Vegetation

Total area of the Western South Dakota River Basins is 26,660,000 acres. (See table A-6). Almost 12 percent of this area is federal land; 2 percent is water or is used for urban and transportation purposes. The remaining 86 percent is private land used for agricultural purposes.

There are 5 million acres of cropland used mainly to produce wheat and hay. Other important crops are oats, corn, sorghum, and barley. Cropland acreage is increasing as more acres of rangeland are being converted to cropland, principally for production of wheat.

Rangeland is the principal land use and consists of over 18 million acres, or 70 percent of the study area. It is used for grazing by livestock and big game animals on which the climax (natural potential) plant community is dominated by grasses, forbs, and shrubs. Rangeland also provides other benefits, including recreation, wildlife habitat, soil erosion control, and natural beauty.

Except for the forest lands the native plant cover consists of mixed prairie vegetation. See Figure A-9. Natural potential vegetation is still present on rangelands that have been maintained in excellent condition. When overgrazed, the condition declines and the taller more palatable grasses and forbs are replaced by plants that are shorter or less palatable. Accelerated soil erosion does not usually occur until rangelands are reduced to poor condition.

Pastureland consists of slightly over 1 percent of the total area and is used, primarily, for grazing; however plant species are different than are grown on rangeland. Pastures are areas that have been converted from cropland or rangeland and seeded to introduced grasses and legumes. Alfalfa, bromegrass, crested wheatgrass, and intermediate wheatgrasses are the most common plant species.

Other lands, comprising 345,200 acres, include farmsteads, farm roads, feedlots, gravel pits, rural nonfarm residential areas, investment tracts, dunes, badlands, and marshes not used for grazing. These lands amount to slightly over 1 percent of the total area.

Water areas covering 339,000 acres include all ponds and lakes of more than 2 acres.

Urban and transportation areas cover 116,100 acres. This includes cities, villages, and built-up areas of more than 10 acres. Industrial sites, railroad yards, cemeteries, airports, golf courses, institutional and public administration sites, roads, and railroad acreage are also included in these areas.

Forest land contains about 1,700,000 acres, or 7 percent of the study area. About 64 percent of this forest land is in or near the Black Hills and the tree cover is predoninately ponderosa pine. On much of this land the tree cover is open with an understory of grasses and forbs. Much of the remaining forest land occurs along streams and the cover consists of a mixture of deciduous trees and shrubs. These areas provide habitat and food for wildlife. See tables A-7 and A-8 for a detailed breakdown of forest lands.

Table A-6 - WATER AREA AND MAJOR LAND USES

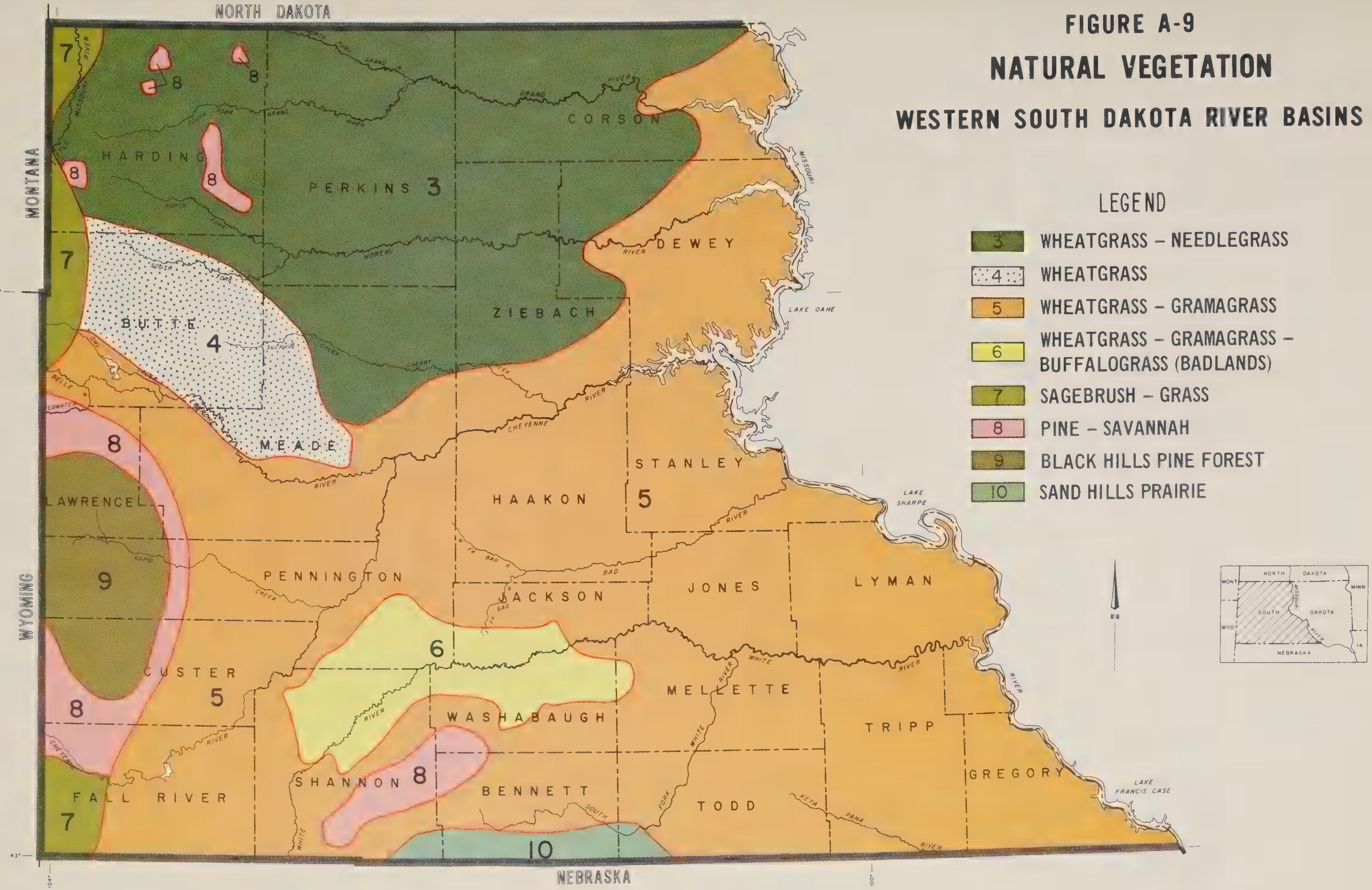
Use	Non-Federal (1,000 acres)	Federal (1,000 acres)	Total (1,000 acres)
Rangeland	16,776.0	2,145.6 3/	18,921.6
Pasture	362.1	---	362.1
Cropland	5,023.5	---	5,023.5
Forest	544.5 1/	1,008.6	1,553.1
Other Land	345.2 2/	---	345.2
Water Area	339.0	---	339.0
Urban and Transportation	116.1	---	116.1
Total	23,506.4	3,154.2	26,660.6

1/ Acreage from a recent inventory. This is a decrease of 30,900 acres from what was used in the LP model.

2/ Adjustment in acreage was made so that the total acreage checked with the 1967 CNI data.

3/ Also includes other uses.

FIGURE A-9
NATURAL VEGETATION
WESTERN SOUTH DAKOTA RIVER BASINS



SOURCE:
FAMILY OF MAPS S.C.S. DRWG. NO. 5,R-30,116 (5-8-72)
AND SOUTH DAKOTA NATURAL VEGETATION MAP
S.C.S. DRWG. NO. 5,P-35,738(6-15-76).
LAMBERT CONFORMAL CONIC PROJECTION

7-31-78
5,N-36,986

USDA-SCS-LINCOLN, NEBR. 1978

Table A-7 - FOREST LAND (ACRES)

Ownership	Unproductive 1/	Productive 2/	Total
State & Private	140,411	404,119	544,530
Bureau of Land Management	2,705	5,820	8,525
U.S. Forest Service			
Black Hills			1,131,830
Regulated 3/		903,310	971,100
Unregulated 4/		38,710	
Reserved 5/		1,190	
Unproductive	27,890		
Custer			29,000
Regulated		22,000	
Unproductive	7,000		
Subtotal - Federal	37,595	971,030	1,008,625
Total	178,006	1,375,149	1,553,155

1/ Forest land that is not capable of producing crops of industrial wood because of adverse site conditions.

2/ Forest land producing or capable of producing crops of industrial wood (minimum 20 cubic feet per acres per year).

3/ Managed to include timber production under sustained yield principles.

4/ This is commercial forest land that is not managed for timber production on a planned basis.

5/ Forest land withdrawn from timber utilization because of statute or administrative regulation.

Table A-8 - ACRES OF STATE AND PRIVATE FOREST LAND

County	Productive			Unproductive			All Forest Land		
	Total	Grazed	Not	Total	Grazed	Not	Total	Grazed	Not
Custer	47,893	47,893	0	15,239	15,239	0	63,132	63,132	0
Custer State Park	52,072	0	52,072	17,928	0	17,928	70,000	0	70,000
Fall River	38,070	38,070	0	27,071	27,071	0	65,141	65,141	0
Lawrence	75,553	54,476	21,077	13,700	13,700	0	89,253	68,176	21,077
Meade	27,917	27,917	0	8,547	8,547	0	36,464	36,464	0
Pennington	42,088	42,088	0	4,698	4,698	0	46,786	46,786	0
Bennett	12,700	12,700	0	6,200	3,500	2,700	18,900	16,200	2,700
Butte	4,518	4,518	0	4,949	4,949	0	9,467	9,467	0
Corson	9,800	9,800	0	3,900	3,900	0	13,700	13,700	0
Dewey	1,600	1,400	200	600	60	540	2,200	1,460	740
Gregory	11,900	3,900	8,000	5,900	5,900	0	17,800	9,800	8,000
Haakon	3,100	3,100	0	900	900	0	4,000	4,000	0
Harding	6,369	6,069	300	779	0	779	7,148	6,069	1,079
Jackson	1,100	1,100	0	600	600	0	1,700	1,700	0
Jones	1,400	1,400	0	700	700	0	2,100	2,100	0
Lyman	3,400	1,400	2,000	1,700	1,700	0	5,100	3,100	2,000
Mellette	4,900	4,500	400	2,300	2,100	200	7,200	6,600	600
Perkins	6,339	6,339	0	0	0	0	6,339	6,339	0
Shannon	15,900	15,500	400	7,900	7,500	400	23,800	23,000	800
Stanley	2,400	2,400	0	700	700	0	3,100	3,100	0
Todd	8,800	8,800	0	4,300	4,300	0	13,100	13,100	0
Tripp	5,200	5,200	0	2,600	2,600	0	7,800	7,800	0
Washabaugh	15,300	15,300	0	7,500	7,500	0	22,800	22,800	0
Ziebach	5,800	5,800	0	1,700	1,700	0	7,500	7,500	0
Total	404,119	319,670	84,449	140,411	117,864	22,547	544,530	437,534	106,996

The five counties in the Black Hills area have recent inventory data available. The areas are from the new inventory with the distribution between grazing and non-grazing in the same proportion as the 1970 Conservation Needs Inventory data.

Wildlife Habitat

Soil interpretations for wildlife habitat suitability are shown in figure A-10. 1/ The soils were rated for their suitability to produce wildlife habitat appropriate to four kinds of wildlife - farmland wildlife, woodland wildlife, wetland wildlife, and rangeland wildlife. Habitat ratings resulted in 15 wildlife suitability groupings.

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and soils affect the construction opportunities involving wetlands. The kind and abundance of wildlife that populates an area depends largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife is either scarce or does not inhabit the area.

Soil ratings for wildlife habitat suitability provide information useful in planning for parks, wildlife refuges, nature study areas, and other developments involving wildlife. The information is also useful in selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat. Soil ratings for wildlife habitat suitability also provide information for determining the intensity of management needed for each element of habitat.

1/ "Soil Associations of South Dakota," Agricultural Experiment Station, SDSU, Brookings, S. Dak., and USDA, SCS, AES Information Series, No. 3, January 1971, 1 map illustrated.

Water Use

Recreation

There are 304,000 surface acres of public water in the study area 2/ of which approximately 164,000 acres are suitable for water sports. Water sports include boating, water skiing, swimming, sailing, and fishing.

Where these waters are associated with public lands developed for recreation, basic facilities often provide for boat launching, beach activities, camping, picnicking, field sports, hiking, and nature trails. These areas usually provide fishing and waterfowl hunting, also.

Excellent pond fishing and waterfowl hunting opportunities are provided by privately owned livestock watering ponds throughout the study area.

Irrigation

About 125,000 acres are irrigated at the present time. Potentials and limitations for additional irrigation developments will depend upon the availability of water. Using the estimated 80 percent chance surface water yields for the major streams in the study area, the amount of potential irrigation is shown for one of the following alternatives:

(1) 200,000 acres - by installing storage reservoirs in the major streams which would utilize the total 80 percent chance annual water yield; or
(2) 38,000 acres - by diverting and/or pumping into off-stream for storage reservoirs for the period of March through August; or
(3) 15,000 acres - by direct diversion and/or pumping from streams during the growing season.

It is estimated that 17,000 acres could be irrigated from ground water sources near the Nebraska state line in Tripp, Todd, and Bennett Counties.

There are approximately 50,000 acres of irrigable soils within 5 miles of the mainstem reservoirs. It is estimated that these soils could be irrigated with water from the mainstem reservoirs. To develop any substantial amount greater than this will depend on the feasibility of piping mainstem waters greater distances at greater costs.

2/ "1975 South Dakota Comprehensive Outdoor Recreation Plan."

INTERPRETATIONS TABLE
WILDLIFE HABITAT

WILDLIFE HABITAT GROUPING COLOR CODE	GOOD SUITABILITY FOR KIND OF WILDLIFE HABITAT	FAIR SUITABILITY FOR KIND OF WILDLIFE HABITAT	POOR SUITABILITY FOR KIND OF WILDLIFE HABITAT	VERY POOR SUITABILITY FOR KIND OF WILDLIFE HABITAT
	FARMLAND WILDLIFE RANGELAND WILDLIFE			WOODLAND WILDLIFE WETLAND WILDLIFE
	FARMLAND WILDLIFE	RANGELAND WILDLIFE		WOODLAND WILDLIFE WETLAND WILDLIFE
	FARMLAND WILDLIFE	RANGELAND WILDLIFE	WOODLAND WILDLIFE	WETLAND WILDLIFE
	RANGELAND WILDLIFE			FARMLAND WILDLIFE WOODLAND WILDLIFE WETLAND WILDLIFE
	RANGELAND WILDLIFE		FARMLAND WILDLIFE	WOODLAND WILDLIFE WETLAND WILDLIFE
	RANGELAND WILDLIFE	FARMLAND WILDLIFE		WOODLAND WILDLIFE WETLAND WILDLIFE
	WOODLAND WILDLIFE			FARMLAND WILDLIFE RANGELAND WILDLIFE WETLAND WILDLIFE
		WOODLAND WILDLIFE RANGELAND WILDLIFE		FARMLAND WILDLIFE WETLAND WILDLIFE
	WETLAND WILDLIFE	RANGELAND WILDLIFE	WOODLAND WILDLIFE	FARMLAND WILDLIFE
		RANGELAND WILDLIFE WETLAND WILDLIFE	WOODLAND WILDLIFE	FARMLAND WILDLIFE
		RANGELAND WILDLIFE	FARMLAND WILDLIFE WETLAND WILDLIFE	WOODLAND WILDLIFE
		FARMLAND WILDLIFE RANGELAND WILDLIFE		WOODLAND WILDLIFE WETLAND WILDLIFE
		RANGELAND WILDLIFE	FARMLAND WILDLIFE	WOODLAND WILDLIFE WETLAND WILDLIFE
		RANGELAND WILDLIFE		FARMLAND WILDLIFE WOODLAND WILDLIFE WETLAND WILDLIFE
			RANGELAND WILDLIFE	FARMLAND WILDLIFE WOODLAND WILDLIFE WETLAND WILDLIFE

GOOD SUITABILITY: HABITATS CAN BE EASILY ESTABLISHED, CONSTRUCTED, IMPROVED, OR MAINTAINED. THERE ARE FEW OR NO SOIL LIMITATIONS IN HABITAT MANAGEMENT, AND SATISFACTORY RESULTS ARE GENERALLY ASSURED.

FAIR SUITABILITY: HABITATS USUALLY CAN BE ESTABLISHED, CONSTRUCTED, IMPROVED, OR MAINTAINED ON THESE SOILS, BUT THERE ARE MODERATE SOIL LIMITATIONS THAT AFFECT HABITAT MANAGEMENT OR CONSTRUCTION. A MODERATE INTENSITY OF MANAGEMENT AND FAIRLY FREQUENT ATTENTION MAY BE REQUIRED TO ASSURE SATISFACTORY RESULTS.

POOR SUITABILITY: HABITATS CAN FREQUENTLY BE ESTABLISHED, CONSTRUCTED, IMPROVED, OR MAINTAINED ON THESE SOILS, BUT THERE ARE RATHER SEVERE SOIL LIMITATIONS. HABITAT ESTABLISHMENT, MANAGEMENT, OR CONSTRUCTION MAY BE DIFFICULT, EXPENSIVE, OR REQUIRE INTENSIVE EFFORT. RESULTS ARE QUESTIONABLE.

VERY POOR SUITABILITY: NATURALLY OCCURRING HABITATS CAN SOMETIMES BE MAINTAINED WITH SPECIFIC MANAGEMENT, BUT IT IS GENERALLY NOT POSSIBLE OR FEASIBLE TO ESTABLISH, CONSTRUCT, OR IMPROVE HABITAT ON THESE SOILS.

DESCRIPTIONS OF KINDS OF WILDLIFE FOR WHICH SUITABILITY RATINGS ARE MADE

FARMLAND WILDLIFE

INCLUDES ANIMALS THAT FREQUENT CROPLANDS, PASTURES, MEADOWS, AND PLANTED WOODLANDS. ALTHOUGH THESE WILDLIFE USE OTHER AREAS, SUCH AS NATURALLY WOODED LANDS AND HEAVILY VEGETATED MARSHLANDS, THEY ARE MOST CLOSELY ASSOCIATED WITH THE CULTURED AREAS. EXAMPLES OF THIS KIND OF WILDLIFE ARE PHEASANT, GRAY PARTRIDGE, MOURNING DOVE, COTTONTAIL, JACKRABBIT, FOX, RACOON, AND WHITETAIL DEER.

WOODLAND WILDLIFE

INCLUDES ANIMALS THAT OCCUR ON AREAS OF NATURALLY WOODED LANDS. THESE LANDS ARE BORDERED BY, AND FREQUENTLY HAVE INCLUSIONS OF FARMLAND, RANGE, AND PASTURE. THE OCCURRENCE OF NATURALLY WOODED LANDS IS, HOWEVER, THE HABITAT ELEMENT AFFECTING WILDLIFE. EXAMPLES OF THIS KIND OF WILDLIFE ARE MULE DEER, WHITETAIL DEER, COTTONTAIL, TREE SQUIRRELS, RACOON, COYOTE, TURKEY, THRUSHES, VIREOS, AND SCARLET TANAGER.

WETLAND WILDLIFE

INCLUDES ANIMALS THAT USE WETLANDS, IMPROVED NATURAL WETLANDS, OR DEVELOPED WETLANDS FOR ALL OR PART OF THEIR NEED FOR BREEDING HABITAT. EXAMPLES OF THIS KIND OF WILDLIFE ARE DUCKS, GEESE, HERONS, SHOREBIRDS, COOT, RED-WINGED BLACKBIRD, MUSKRAT, AND BEAVER.

RANGELAND WILDLIFE

INCLUDES ANIMALS THAT OCCUR ON AREAS MAINTAINED IN NATIVE PLANT COMMUNITIES, NORMALLY REFERRED TO AS RANGE. AREAS OF RANGE FREQUENTLY INCLUDE WOODED DRAWS, WOODED ALLUVIAL LANDS, AREAS OF FARMING, AND SOME PLANTED WOODLAND. THE OCCURRENCE OF RANGE, HOWEVER, IS THE MAJOR HABITAT ELEMENT AFFECTING WILDLIFE. EXAMPLES OF THIS KIND OF WILDLIFE ARE MULE DEER, WHITETAIL DEER, ANTELOPE, JACKRABBIT, COYOTE, SHARP-TAILED GROUSE, HORNED LARK, LARK BUNTING, AND MOURNING DOVE.

<PE 31 >PE 31 PRECIPITATION EFFECTIVENESS INDEX (PE LINE)

BOUNDARY FOR WILDLIFE HABITAT GROUPING

USDA-SCS-LINCOLN, NEBR 1978

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

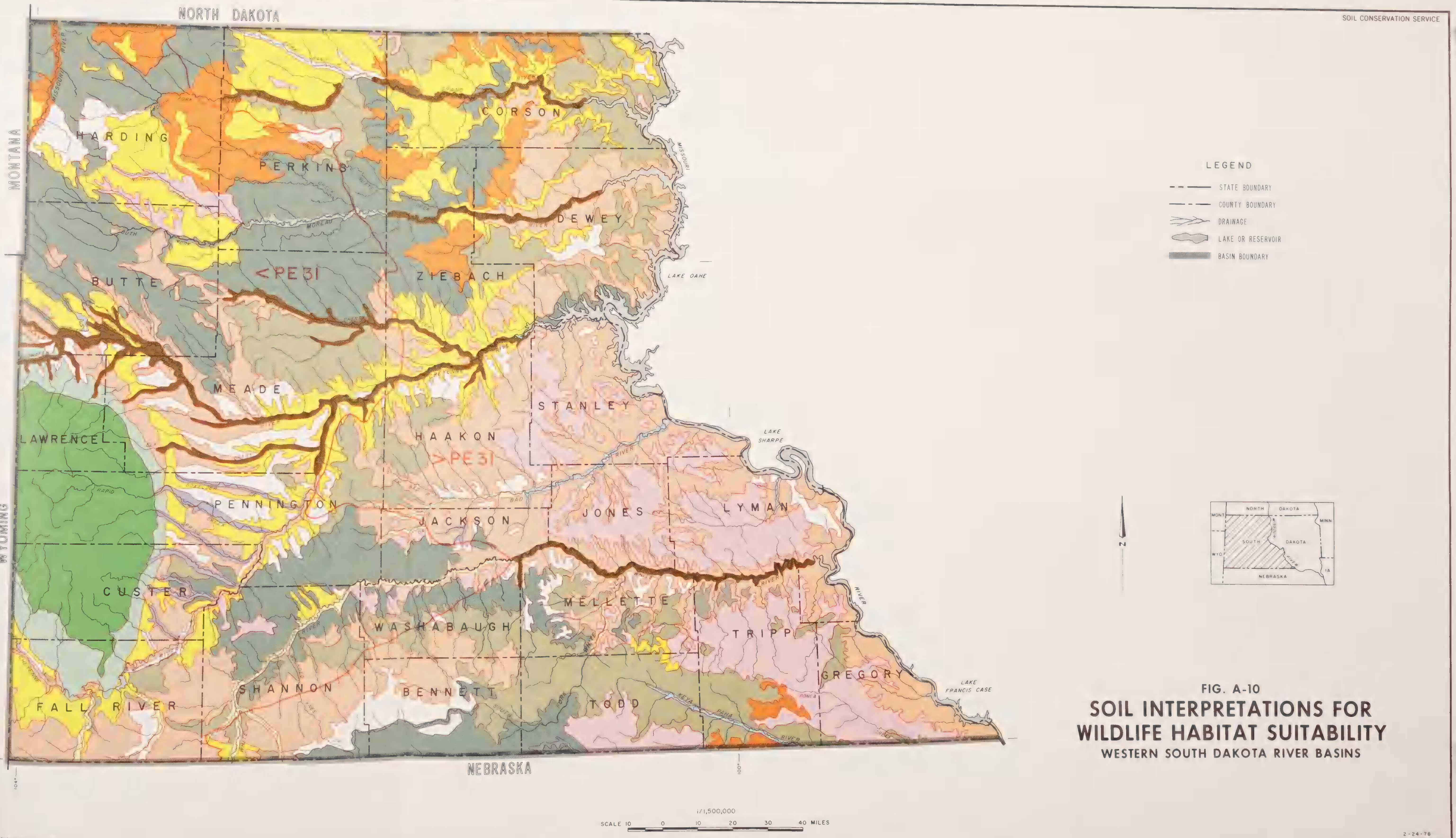


FIG. A-10

SOIL INTERPRETATIONS FOR WILDLIFE HABITAT SUITABILITY

WESTERN SOUTH DAKOTA RIVER BASINS

SOURCE
SCS DRAWING 5,R-30,116 (5-72) AND
INFORMATION FROM FIELD TECHNICIANS.
LAMBERT CONFORMAL CONIC PROJECTION
SCS LINCOLN NEBR 1978

2-24-78
5,S-36,674

ECONOMIC BASE AND PROJECTIONS

APPENDIX B

Economic Base and Projections

Economic Activity

Before establishing the economic base of the study area it is necessary to choose a measure of economic activity and to choose a method to be used with that measure. The measure here chosen is that of earnings and the method used is the location quotient (L.Q.). Earnings were selected over employment or income as measures because the rewards for employment in all degrees are reflected in earnings. Earnings by the self-employed are counted while employment data often are not. A better base for impact analysis is provided by earnings through provision of an indicator of the generation of local revenues and thus, secondary effects. Earnings reflect degree of productivity, suitable data is available by sector and they are reflective of the place it was generated.

The location quotient is the ratio of the percentage of total regional earnings made up by one sector in the region to the percentage of total earnings made up by the same industry for a basic aggregate. The basic aggregate is the nation as a whole. The range of the L.Q. is from zero to infinity. An L.Q. between zero and one means the percentage of total economic activity attributable to that sector within the region is less than the similar percentage found nationally. If a sector is found to have an L.Q. equal to one, it indicates that the production within the sector is sufficient to satisfy local demands. L.Q.'s greater than one indicate that the region produces more than enough of the goods and services to satisfy local demands. Thus, such goods and services will be surplus and exported from the region. Conclusions as to the qualities of the L.Q. are based on a series of assumptions: the region's demand for goods and services are proportional to the nation's demands; production functions are homogenous throughout the nation for each sector; and importation of the same good that is exported is minimal, if existent.

The L.Q.'s for broad industrial classifications for selected years since 1950 are shown in Table B-1. The location quotients for agriculture, government and the other sector exceed one and are therefore surplus for the study area. The L.Q. for agriculture increased erratically between 1950 and 1967, following which a modest declining trend is shown. Government and other sectors had rather stable L.Q.'s over the years listed and at levels substantially lower than that of agriculture. All other sectors have L.Q.'s of less than one and therefore importation occurs in satisfying the region's demands for goods and services. In terms of percentage earnings as a sector among all sectors, total government earnings exceeded those of agriculture since 1965. This is shown in Table B-2 for the entire study area. Agricultural earnings have been erratic but second only to total government.

Table B-1 - LOCATION QUOTIENTS

Sector	1950	1959	1962	1965	1966	1967	1968	1969
Agriculture	3.71	3.73	7.35	4.81	5.54	7.82	7.55	7.46
Total Government	1.60	1.86	1.19	1.75	1.72	1.65	1.61	1.69
Total Federal	2.21	2.81	1.78	2.76	2.66	2.52	2.41	2.49
State & Local	.96	.98	.71	.98	.99	1.01	1.01	1.12
Manufacturing	.21	.21	.17	.20	.21	.12	.16	.13
Mining	.20	.40	.34	.52	.50	.44	.31	.30
Contract Construction	1.42	1.66	1.89	1.14	.98	.74	.85	.76
Transportation, Communication & Public Utilities	.56	.75	.74	.72	.73	.64	.62	.65
Wholesale & Retail Trade	.79	.90	.74	.93	.88	.83	.90	.87
Services	.73	.76	.62	.78	.75	.73	.78	.75
Finance, Insurance & Real Estate	.26	.45	.34	.49	.49	.48	.46	.44
Other	.68	1.14	1.01	1.43	1.32	1.48	1.51	1.40

Source: Regional Economics Information System, Office of Business Economics.

Table B-2 - DISTRIBUTION OF EARNINGS AMONG SECTORS

Sector	1950	1959	1962	1965	1966	1967	1968	1969
	Percent							
Agriculture	32.32	16.68	32.27	19.48	22.12	27.17	24.05	24.60
Total Government	18.21	26.18	18.16	27.29	27.57	27.49	27.23	28.59
Total Federal	12.85	18.96	12.23	18.51	18.56	17.98	17.40	17.55
State & Local	5.36	7.22	5.93	8.78	9.01	9.51	9.83	11.04
Manufacturing	6.23	6.48	5.10	6.07	6.19	3.65	4.61	3.65
Mining	0.40	0.57	0.43	0.59	0.54	0.46	0.31	0.30
Contract Construction	8.45	10.20	11.13	6.99	5.97	4.41	5.09	4.72
Transportation, Communication & Public Utilities	4.60	5.80	5.45	5.14	5.15	4.47	4.31	4.51
Wholesale & Retail Trade	15.01	16.12	12.80	15.77	14.81	13.86	14.90	14.25
Services	8.26	9.71	8.42	10.82	10.30	10.58	11.27	11.09
Finance, Insurance & Real Estate	1.10	2.27	1.72	2.49	2.42	2.48	2.40	2.30
Other	5.42	5.99	4.52	5.36	4.93	5.43	5.83	5.99

Source: Regional Economics Information System, Office of Business Economics.

Other earnings are earnings not reported by industry sector, for which percentages have remained fairly constant over time. Percentage earnings in the manufacturing and contract construction have declined substantially during the period shown while the remaining sectors have stayed at relatively constant, low percentages. The L.Q.'s follow this same pattern.

Personal Income

In order to develop more comprehensive insight to the economic and social characteristics of the 23-county study area, four economic subareas were designated (Figure B-1).

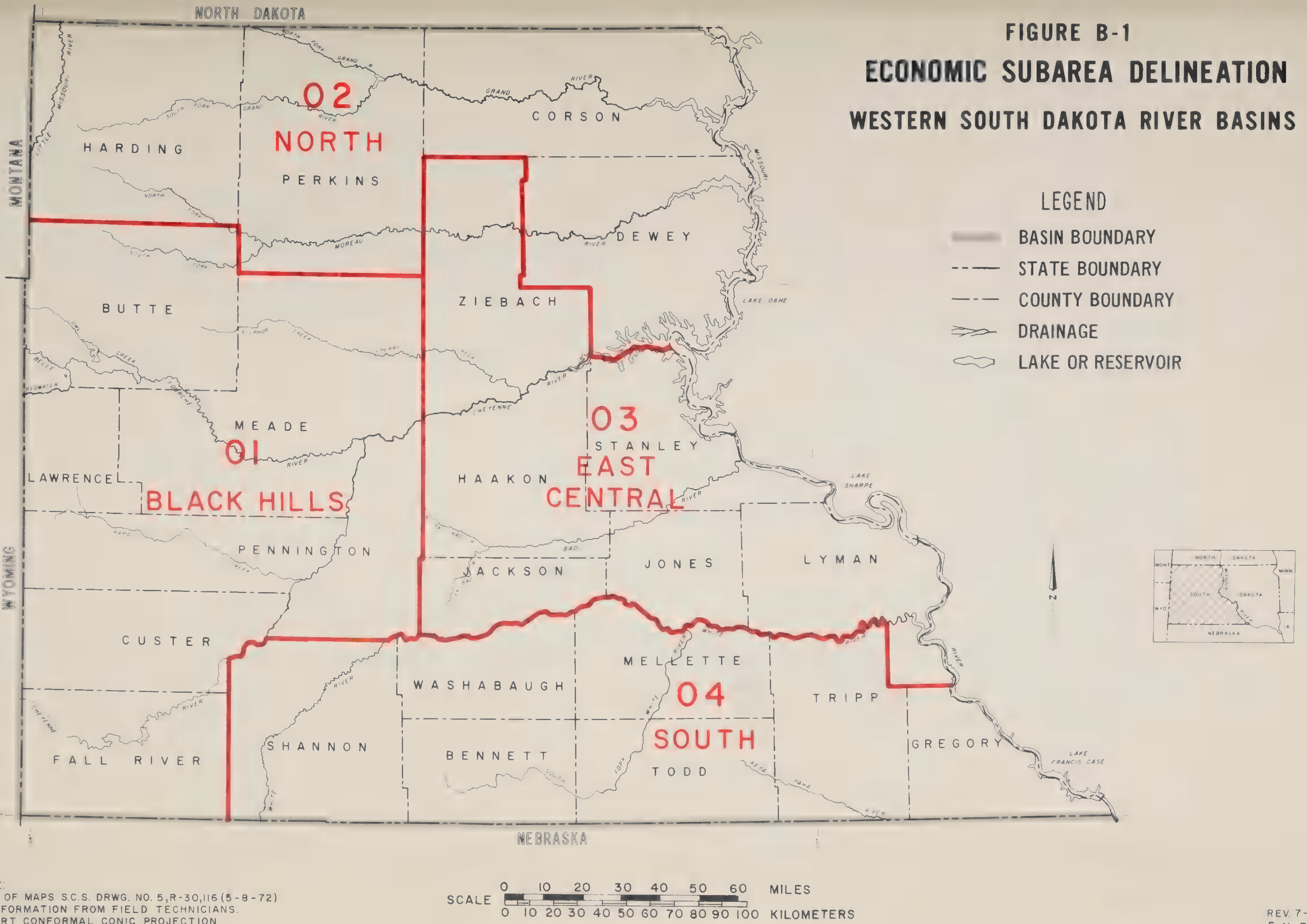
Reference to economic subareas is made in relation to historic data for total personal income. Table B-3 contains personal income data by subarea, for the total area and for the state for the period 1970 through 1975. Total personal income is made up of: total wage and salary disbursements; other labor income; proprietor's income (farm and nonfarm); property income; transfer payments; and is decreased by personal contributions for social insurance. In general, about two-thirds of the total personal income for the area has historically been derived within the Black Hills (subarea 01). The south subarea has consistently had the second highest personal income, with the east central subarea having a rather consistent edge over the northern subarea. Total personal income for the area has trended upward at a moderate rate until 1971 when sharp increases are shown between 1971 and 1975. Historically, one-fourth to one-third of the state's total personal income has derived from the study area, even though it occupies more than half the area of the state.

Total Earnings

The general historic relationships between earnings within the study area and state earnings are depicted in Figures B-2 through B-11. These figures trace the historic earnings performance from 1950 to 1975. Study area trends generally follow those of the state but there are important exceptions. Figure B-5 shows that manufacturing earnings have held steady or declined while earnings for the state have trended rather consistently upward. Earnings from mining show a period of substantial increase in recent years following more than 20 years of stability. Gold, responding to market price, is a major contributor to this sharp increase. Wholesale and retail trade earnings, finance, insurance and real estate earnings and service earnings (Figures B-9, B-10, B-11) have generally increased moderately relative to sharper increases in earnings for the state.

Figures B-2 through B-11 also show projected earnings for the region and the state under both OBERS Series "C" and "E" sets of assumptions. Differences between the two sets of assumptions are

FIGURE B-1
ECONOMIC SUBAREA DELINEATION
WESTERN SOUTH DAKOTA RIVER BASINS



SOURCE:
FAMILY OF MAPS S.C.S. DRWG. NO. 5,R-30,116 (5-8-72)
AND INFORMATION FROM FIELD TECHNICIANS.
LAMBERT CONFORMAL CONIC PROJECTION

REV. 7-18-79
5,N-36,996

Table B-3 - TOTAL PERSONAL INCOME

Economic Subarea	Thousands of Dollars					
	1970	1971	1972	1973	1974	1975
Total Personal Income						
01	377,828	412,921	463,665	545,158	580,092	615,940
02	44,778	51,403	55,329	89,477	74,568	65,348
03	44,183	48,711	56,948	100,014	91,189	75,675
04	86,585	95,216	117,320	168,080	152,839	144,616
Basin Total	553,374	608,251	693,562	902,729	898,688	901,579
State Total	2,085,918	2,234,797	2,577,480	3,380,654	3,311,241	3,364,484

Source: Regional Economics Information System, Office of Business Economics.

Figure B-2. Total Earnings: Historic and Projected, Western South Dakota River Basins

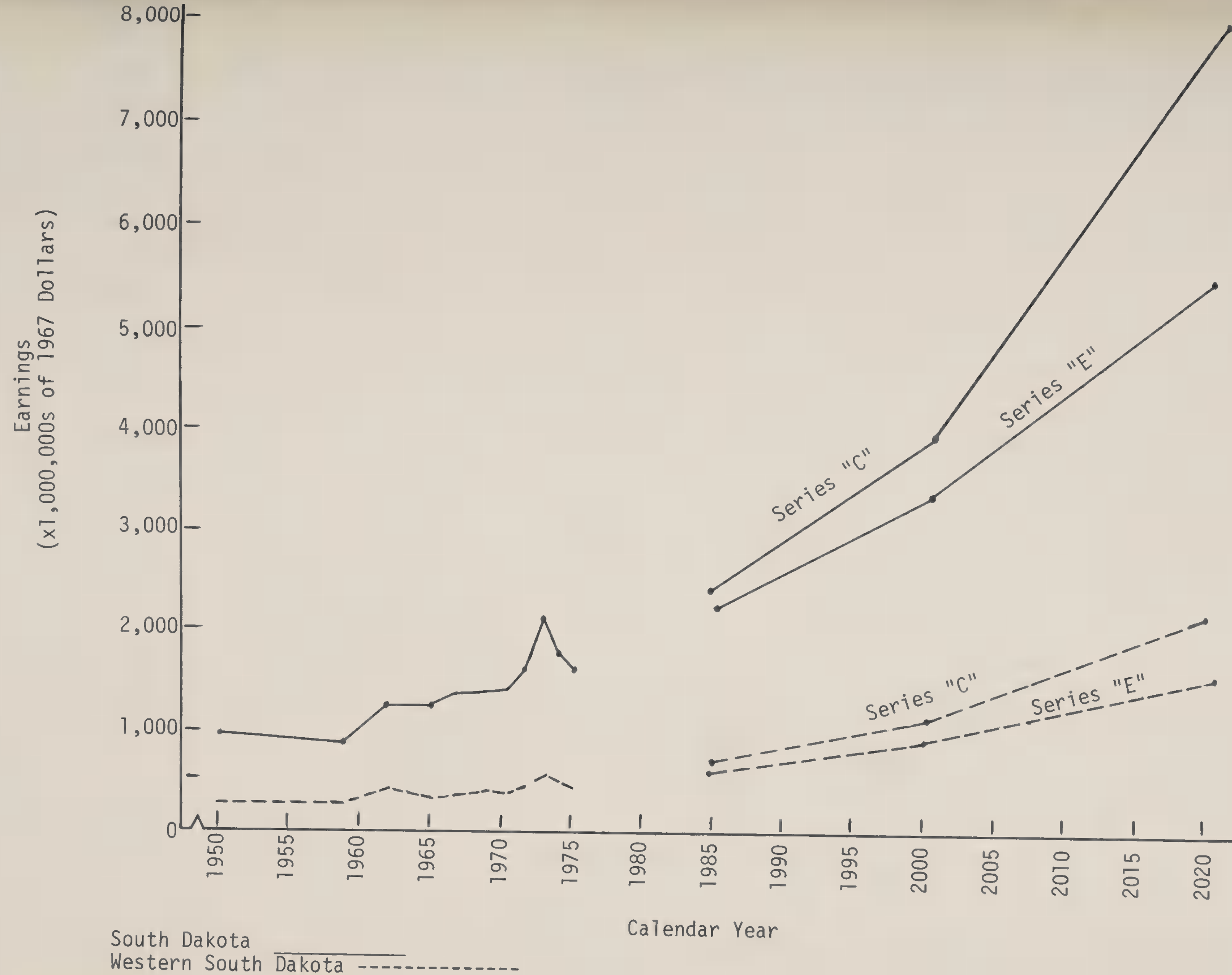


Figure B-3. Agricultural Earnings Historic and Projected, Western South Dakota River Basins

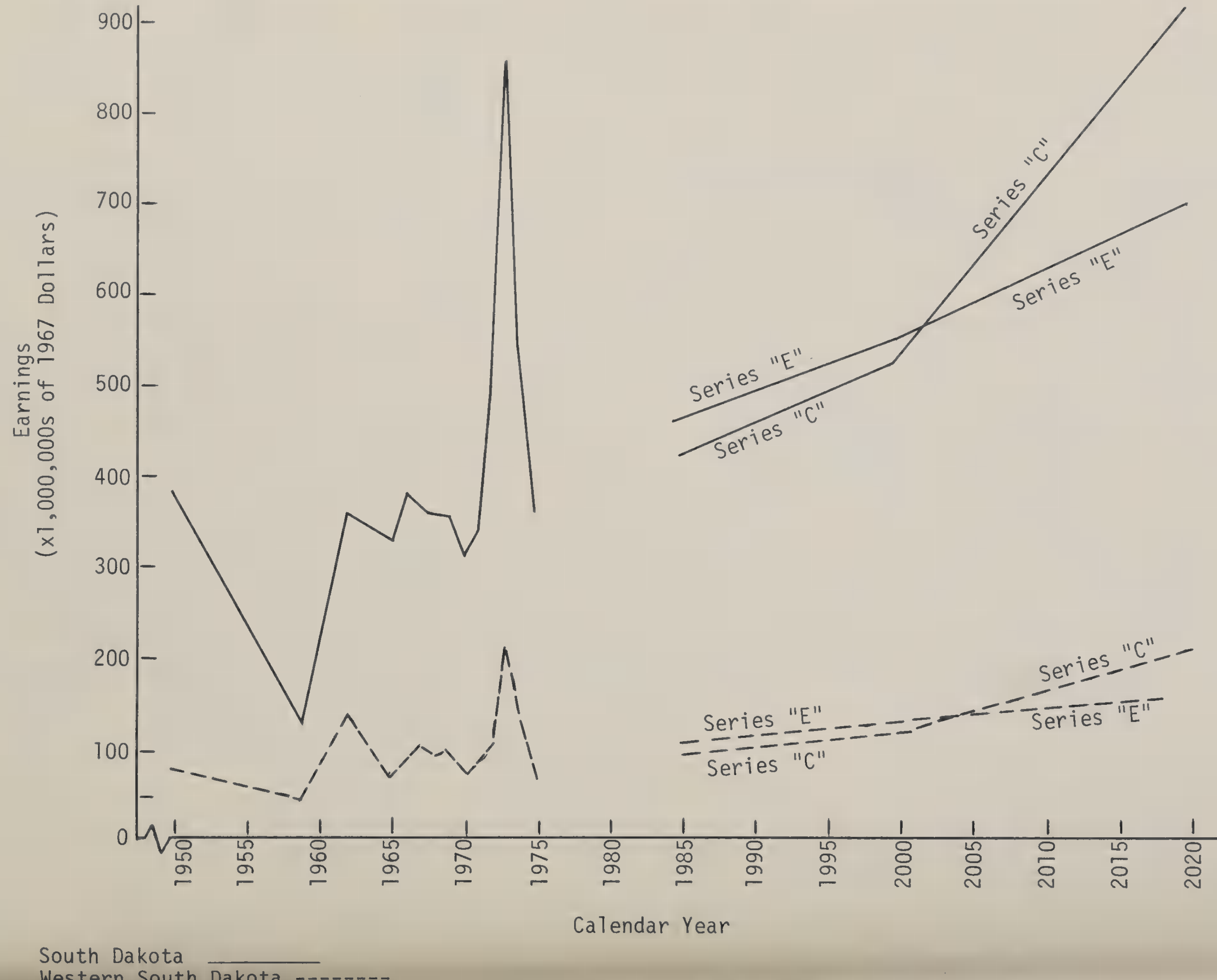


Figure B-4. Government Earnings Historic and Projected, Western South Dakota River Basins.

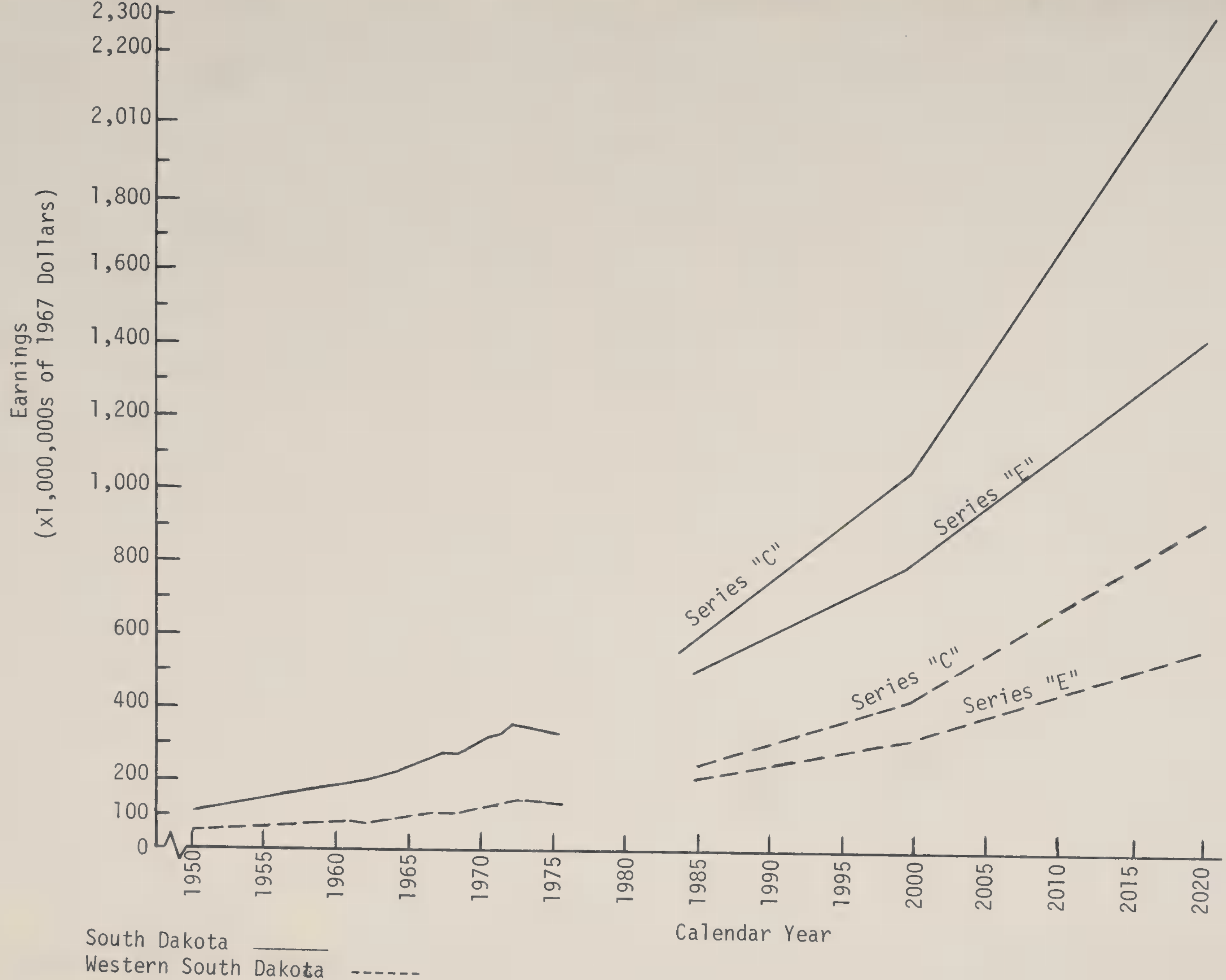


Figure B-5. Manufacturing Earnings Historic and Projected, Western South Dakota River Basins

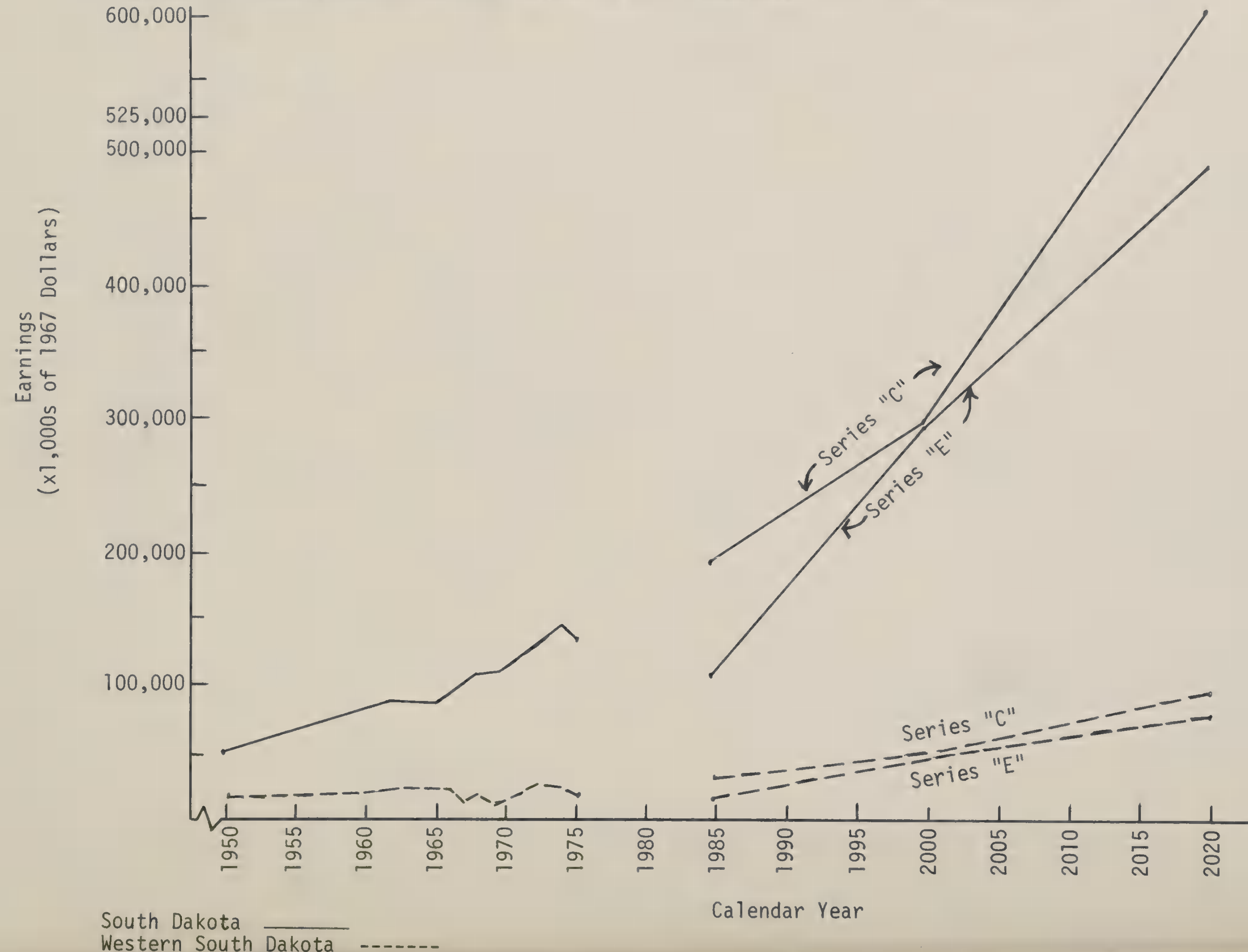


Figure B-6. Earnings from Mining, Historic and Projected, Western South Dakota River Basins

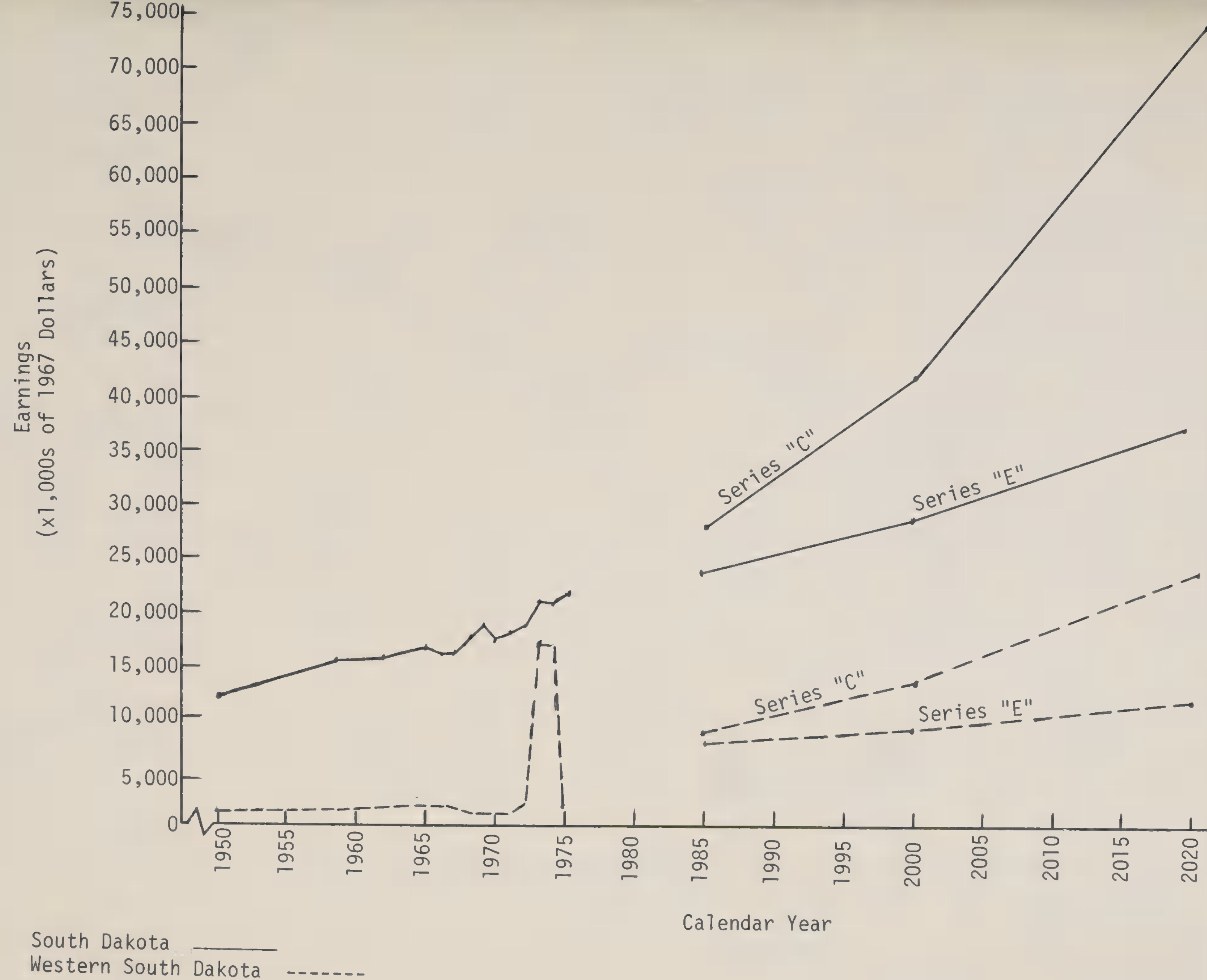


Figure B-7. Contract Construction Earnings Historic and Projected, Western South Dakota River Basins

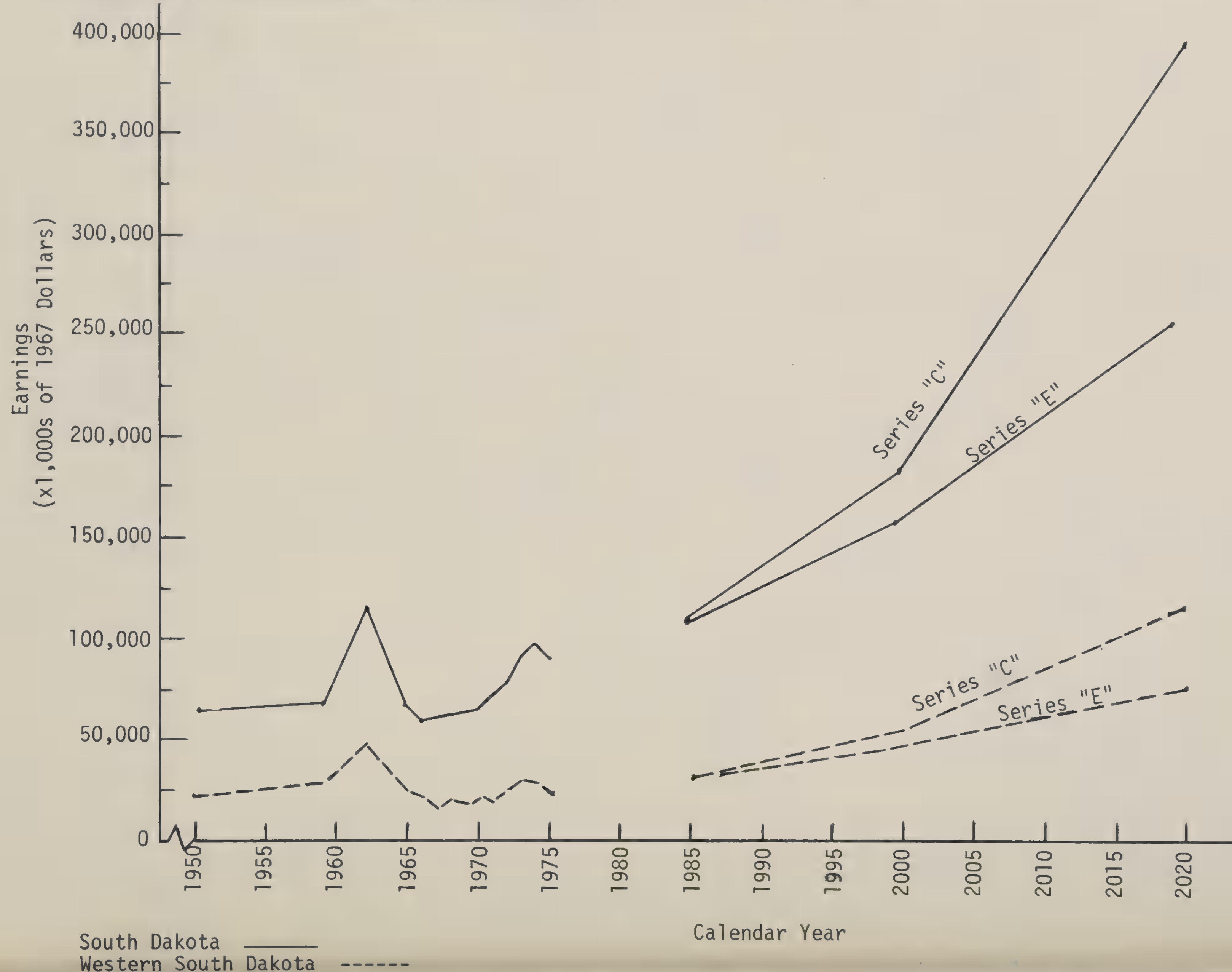


Figure B-8. Transportation, Communication and Public Utilities Earnings Historic and Projected, Western South Dakota River Basins.

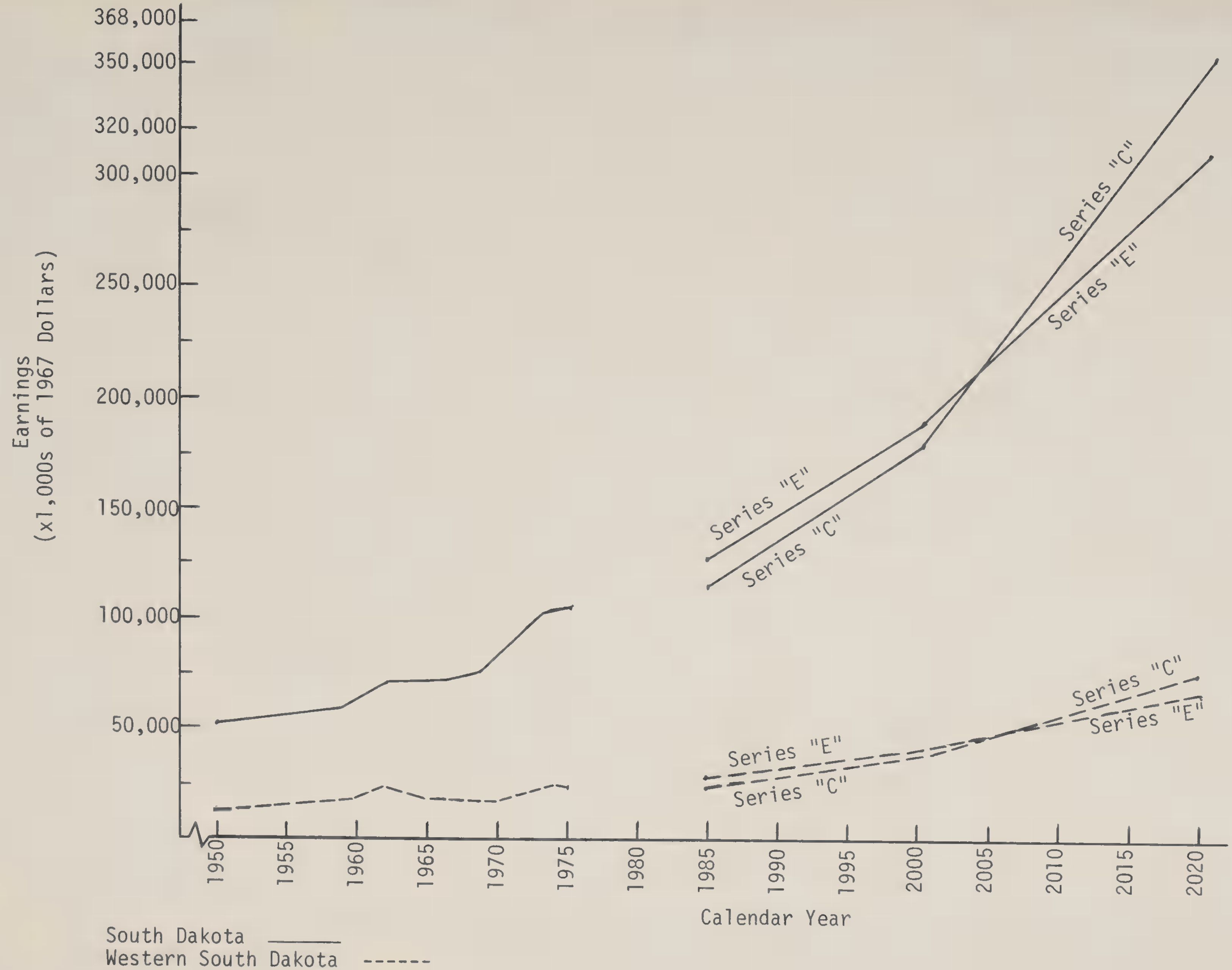


Figure B-9. Wholesale and Retail Trade Earnings Historic and Projected, Western South Dakota River Basins.

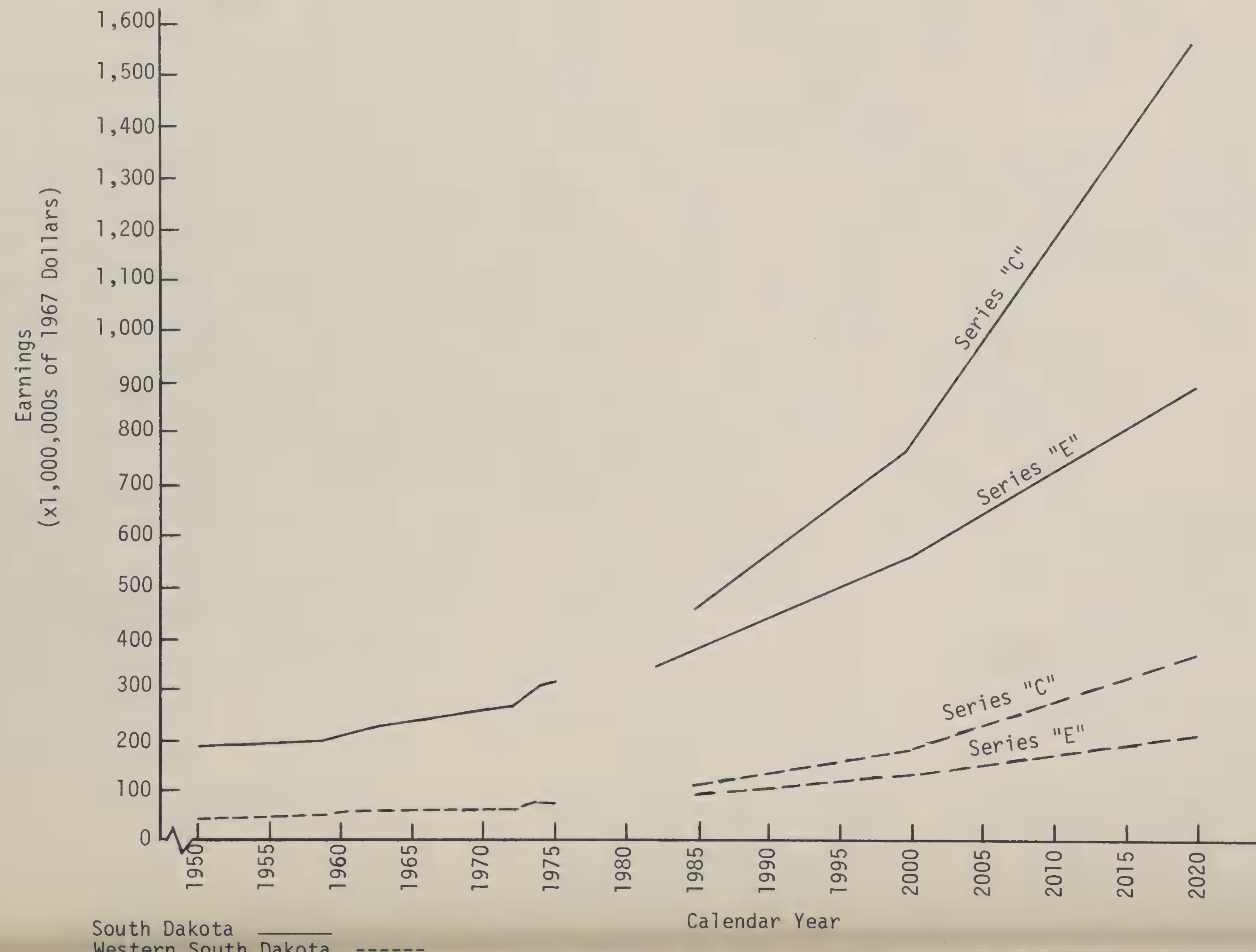


Figure B-10. Finance, Insurance and Real Estate Earnings Historic and Projected, Western South Dakota River Basins.

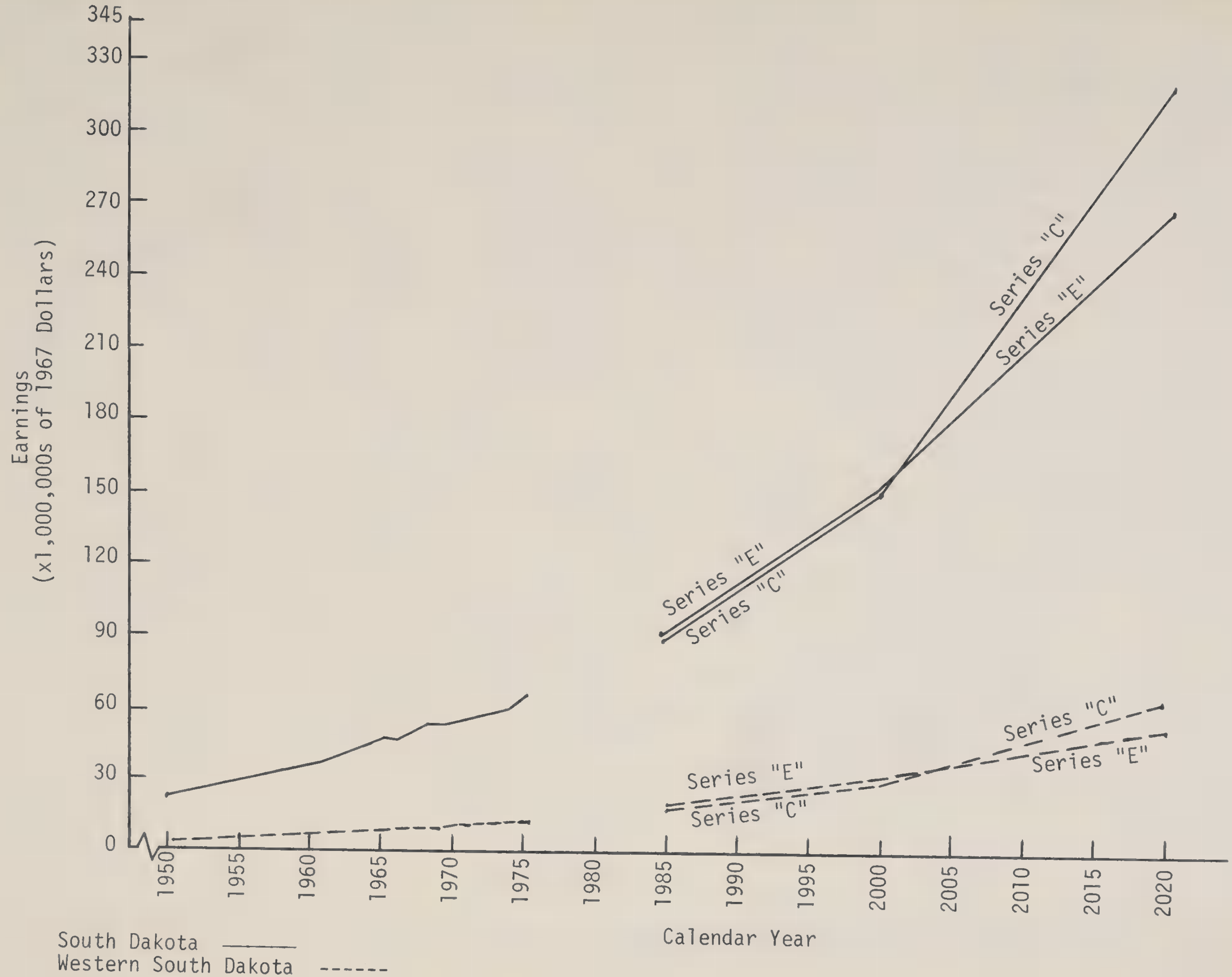
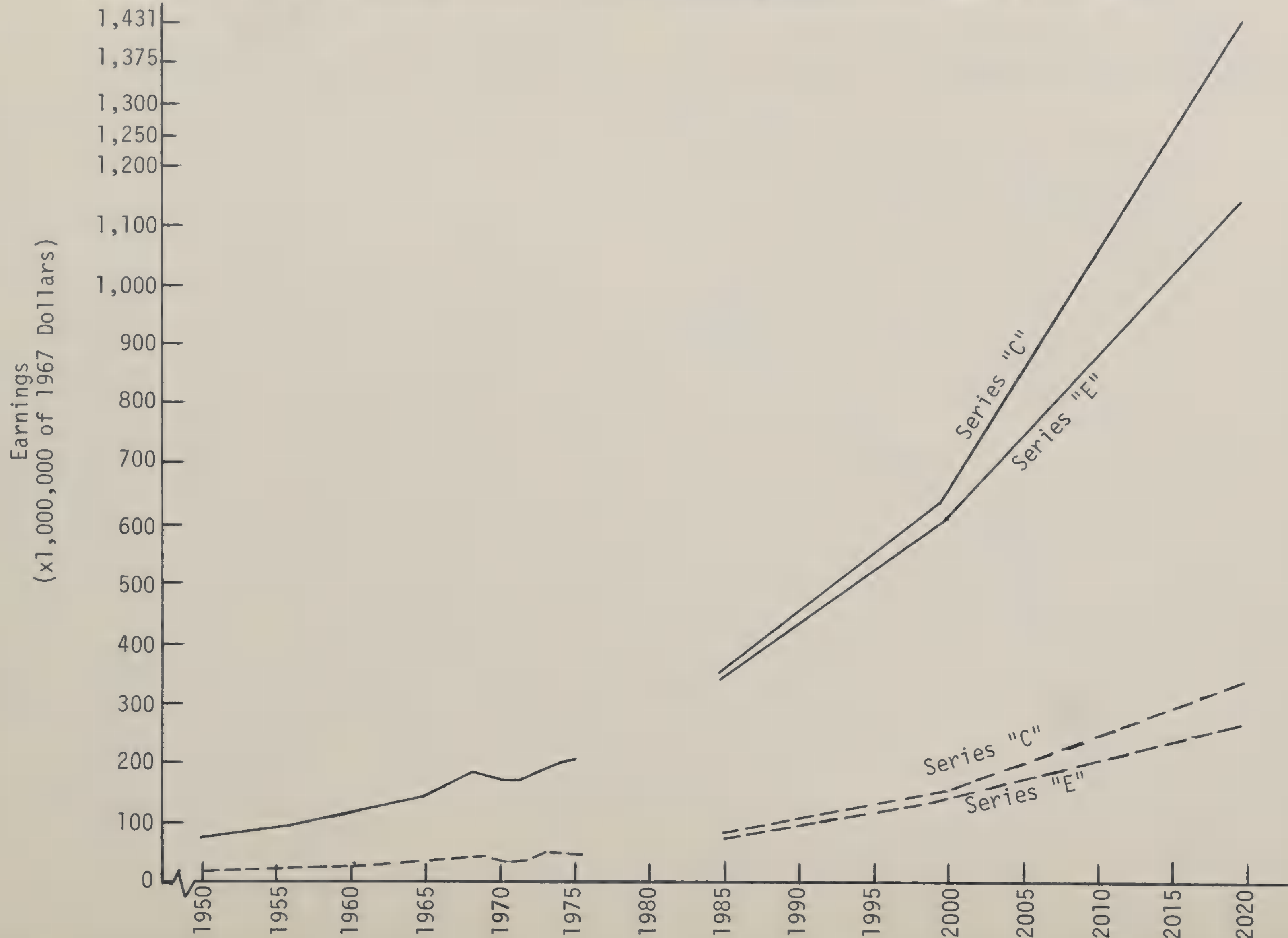


Figure B-11. Service Earnings Historic and Projected, Western South Dakota River Basins.



South Dakota ______
Western South Dakota ------

changes in the rate of fertility from 2.8 births per woman as in the Series "C" to 1.8 births per woman (replacement level fertility) in Series "E". The hours worked per year are projected to decline at the rate of 0.35 percent per year. The Series "C" projections used a 0.25 percent rate. The projected rate of increase in product per man per hour in the private economy is lowered from 3.0 percent to 2.9 percent. More recent employment data were used in developing the basis for the Series "E" projections.

Other differences in the underlying assumptions contributed to the divergence of the two series but some of the more important ones have been stated. Projections are a logical extension of historic performance in relation to whatever parameter is at hand. While historic data are generally available on an annual base and therefore may show wide fluctuation from year to year, projections are point estimates for future years. These relate to the years 1985, 2000 and 2020. A straight line connects any two sequential points in time as in Figures B-2 through B-11. However, the demonstrated historic variability will inevitably appear as we progress through time to the projections year. Projections are useful and necessary tools to demonstrate and quantify the effects of altering basic assumptions. The projected rate of growth is considerable for all series.

Employment and Income

Employment sectors are the same as the previously discussed earnings sectors. Table B-4 shows the percent of total employment afforded within the sectors for the year 1970. The data are presented by economic subarea, for the total basins and the nation. As of 1970, services, wholesale and retail trade and agriculture, forestry and fisheries accounted for more than 69 percent of the total employment.

The occupation groups of all employed persons as of 1970 are listed in Table B-5. For the study area and the state the number of employed persons is greatest for farmers and farm managers, closely followed by the service workers, professional technical, clerical and craftsmen, foreman categories. Numbers employed within employment categories shift considerably within economic subareas in comparison with the study area or the state. Subarea 01 or the Black Hills area accounts for two-thirds of the total employed persons in the basins and the distribution among categories reflects a more diverse economy.

Distribution of annual family income in 1970 is contained in Table B-6. For the study area, the greatest number of families earn family incomes in the range of $10,000 - $14,999. Family earnings in the less than $2,000 and more than $25,000 ranges sum to 11.5 percent of the total number of families in the basins. Both the median and mean income of families are greatest in the Black Hills subarea.

Table B-4 - 1970 DISTRIBUTION OF EMPLOYMENT BY SECTOR[1/]

Sector	Economic Subarea				Total Basin	State	U.S.
	01	02	03	04			
	Percent of Total						
Agriculture, Forestry & Fisheries	10.5	36.6	46.3	34.2	20.6	22.2	3.7
Mining	5.1	-	0.2	0.1	3.3	1.0	0.8
Contract Construction	6.2	9.6	3.2	5.5	6.1	5.4	6.0
Manufacturing	8.3	1.2	1.0	2.7	5.9	7.4	25.9
Transportation, Communication & Public Utilities	6.1	3.6	4.0	3.4	5.2	5.2	6.8
Wholesale & Retail Trade	23.4	18.0	14.3	16.8	20.8	21.6	20.1
Finance, Insurance & Real Estate	4.0	2.4	2.0	2.9	3.5	3.6	5.0
Services	30.1	21.0	22.6	26.4	27.9	28.4	26.2
Government	6.3	7.6	6.4	8.0	6.7	5.2	5.5
Other (not reported)	-	-	-	-	-	-	-
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

1/ Employed persons 16 years of age and over.
Source: U.S. Census, General, Social and Economic Characteristics.

Table B-5 - OCCUPATION GROUP OF ALL EMPLOYED PERSONS, 1970

Employment Category	Economic Subarea				Study Area	State
	01	02	03	04	Total	Total
	Number					
Professional, Technical	5,602	609	597	1,439	8,247	30,561
Manager & Administrative	3,865	374	499	874	5,612	21,964
Sales	2,891	222	194	437	3,744	15,269
Clerical	5,452	467	554	1,220	7,693	30,878
Craftsmen, Foremen	4,699	277	496	768	6,240	23,050
Operative Except Transport	3,182	71	225	436	3,914	14,952
Transport Operator	1,491	179	190	384	2,234	7,820
Laborers Except Farm	1,432	160	143	316	2,051	7,800
Farmers & Farm Managers	2,396	1,940	1,558	2,724	8,618	40,948
Farm Laborers & Foremen	1,037	639	471	947	3,094	10,532
Service Workers	5,870	597	662	1,199	8,328	32,149
Private Household Workers	429	103	54	232	818	4,174
Total Employed	38,336	5,638	5,643	10,976	60,593	240,097

Source: U.S. Census, General, Social and Economic Characteristics.

Table B-6 - DISTRIBUTION OF ANNUAL FAMILY INCOME, 1970

Range in Family Income	Economic Subarea				Study Area	
	01	02	03	04	Total	Percent of Total
	Number of Families					
Less than $2,000	1,646	399	457	1,190	3,692	8.5
$2,000-3,999	3,030	427	622	1,671	5,750	13.2
$4,000-5,999	4,004	598	724	1,357	6,683	15.3
$6,000-7,999	4,836	622	563	1,132	7,153	16.4
$8,000-9,999	4,650	548	460	857	6,515	15.0
$10,000-14,999	6,232	662	608	1,188	8,690	20.0
$15,000-24,999	2,629	301	232	590	3,752	8.6
More than $25,000	761	151	109	272	1,293	3.0
Grand Total	27,788	3,708	3,775	8,257	43,528	100.0
Median Income	8,158	7,345	6,231	5,936	7,500	-
Mean Income	9,263	8,702	7,781	7,705	8,817	-

Source: U.S. Census, General, Social and Economic Characteristics.

Population

Total population and population density within economic subareas, the basins and the state are shown in Table B-7. Subarea 01 shows substantial increases since 1950 while subarea 04 appears to be fairly stable. Subareas 02 and 03 were relatively sparsely populated in 1950 and this characteristic has amplified up to the present time. While the total population of the basin increased between 1950 and 1960, it stabilized during the period 1960 to 1970. The proportion of the total population of the study area relative to the state has declined at an increasing rate over time. Population and population density trends are illustrated in considerably more detail in Table B-8. The data base in time is expanded over that of Table B-7 by the inclusion of 1976 statistics. The more recent data does not substantially change the trends observed above. Data for counties within subareas allows closer scrutiny of where significant changes have occurred. For example, Pennington and Meade Counties in subarea 01 include the major towns and cities within the study area and this is where population growth has occurred. The remainder of the counties in the subarea have shown stability or decline since 1950. In subarea 02, Dewey County shows an increase in population but the remaining counties have declined. Only Stanley County in subarea 03 has increased in population, Ziebach has remained stable and the remaining counties have declined. Shannon and Todd Counties in subarea 04 show population increases while the rest of the counties have declined.

The migration of people to urban communities is demonstrated by the data in Table B-9. Increases in population within subareas have primarily been where there are urban centers. Rural population of the study area in 1970 was at about the same level as in 1950.

Nonwhite population within subareas, the basins and the state between 1950 and 1970 are shown in Table B-10. The data indicate that there have been substantial increases over time in nonwhite population, primarily Indians, within each subarea, the study area and the state. About 20 percent of the increase in total population has been nonwhite. Nonwhite population within the study area is concentrated in subarea 04.

Population change and net migration are clearly demonstrated in Table B-11. Percent of change between 1960 and 1970 shows a preponderance of negative changes within the counties of subareas 02 and 03. Subareas 01 and 04 show a mix of sign internally. The net outcome is that there was virtually no change in total population for the total study area between 1960 and 1970. The state total population decreased by about two percent during that same period. The net migration rate is a negative 3.3 percent greater for the study area than for the state. Changes in subareas 02 and 03 are the primary sources of this negative net migration rate.

Table B-7 - TOTAL POPULATION AND POPULATION DENSITY

Economic Activity	1950		1960		1970	
	Total1/	Sq. Mi.2/	Total	Sq. Mi.	Total	Sq. Mi.
	Number					
Subarea 01	86,334	6.8	111,500	8.8	113,448	9.0
Subarea 02	20,149	1.9	19,403	1.8	16,788	1.6
Subarea 03	16,449	1.9	18,362	2.1	14,953	1.7
Subarea 04	36,115	3.7	33,580	3.5	36,582	3.8
Basin Total	159,047	3.8	182,845	4.4	181,771	4.4
State Total	652,740	8.5	680,514	8.8	665,507	8.6

1/ U.S. Census of Population, South Dakota, Number of Inhabitants.
2/ Area Measurement Reports, Bureau of the Census.

Table B-8 -- TOTAL POPULATION AND POPULATION DENSITY

Economic Subarea	County	1950 Total No.1/	1950 No. Per Sq. Mi.2/	1960 Total No.	1960 No. Per Sq. Mi.	1970 Total No.	1970 No. Per Sq. Mi.	1976 Total No.3/	1976 No. Per Sq. Mi.
01	Butte	8,161	3.6	8,592	3.8	7,825	3.5	8,200	3.6
	Custer	5,517	3.6	4,906	3.2	4,698	3.0	5,100	3.3
	Fall River	10,439	6.0	10,688	6.1	7,505	4.3	8,200	4.7
	Lawrence	16,648	20.8	17,075	21.3	17,453	21.8	17,000	21.3
	Meade	11,516	3.3	12,044	3.5	16,618	4.8	18,700	5.4
	Pennington	34,053	12.3	58,195	21.0	59,349	21.4	70,400	25.3
Total		86,334	6.8	111,500	8.8	113,448	9.0	127,600	10.1
02	Corson	6,168	2.4	5,798	2.3	4,994	2.0	5,000	2.0
	Dewey	4,916	2.6	5,257	2.2	5,170	2.2	6,000	2.5
	Harding	2,289	0.9	2,371	0.9	1,855	0.7	1,800	0.7
	Perkins	6,776	2.4	5,977	2.1	4,676	1.7	4,900	1.7
Total		20,149	1.9	19,403	1.8	16,788	1.6	17,700	1.7
03	Haakon	3,167	1.7	3,303	1.8	2,802	1.5	2,800	1.5
	Jackson	1,768	2.2	1,985	2.5	1,531	1.9	1,600	2.0
	Jones	2,281	2.3	2,066	2.1	1,882	1.9	1,700	1.7
	Lyman	4,572	2.7	4,428	2.7	4,060	2.4	4,000	2.3
	Stanley	2,055	1.4	4,085	2.8	2,457	1.7	2,800	1.8
	Ziebach	2,606	1.3	2,495	1.3	2,221	1.1	2,500	1.3
Total		16,449	1.9	18,362	2.1	14,953	1.7	15,400	1.7
04	Bennett	3,396	2.9	3,053	2.6	3,088	2.6	3,100	2.6
	Gregory	8,556	8.4	7,399	7.4	6,710	6.7	6,600	6.3
	Mellette	3,046	2.3	2,664	2.0	2,420	1.9	2,200	1.7
	Shannon	5,669	2.7	6,000	2.9	8,198	3.9	8,700	4.1
	Todd	4,758	3.4	4,661	3.4	6,606	4.8	7,300	5.3
	Tripp	9,139	5.6	8,761	5.4	8,171	5.0	8,000	4.9
	Washabaugh	1,551	1.5	1,042	1.0	1,389	1.3	1,500	1.4
Total		36,115	3.7	33,580	3.5	36,582	3.8	37,400	3.9
Basin Total		159,047	3.8	182,845	4.4	181,771	4.4	198,100	4.8
State Total		652,740	8.5	680,514	8.8	665,507	8.6	686,000	8.9

1/ U.S. Census of Population, South Dakota, Number of Inhabitants.
2/ Area Measurement Reports, Bureau of the Census.
3/ U.S. Department of Commerce, Bureau of the Census, "Estimates of the Population of South Dakota Counties: July 1, 1975 and 1976."

Table B-9 - URBAN VS. RURAL POPULATION

Economic Subarea	1950		1960		1970	
	Urban	Rural	Urban	Rural	Urban	Rural
Subarea 01	49,816	36,518	69,006	42,494	76,099	37,349
Subarea 02	2,760	17,389	-	19,403	-	16,788
Subarea 03	-	16,449	2,649	15,713	-	14,953
Subarea 04	5,887	30,228	3,705	29,875	6,557	30,025
Basin Total	58,463	100,584	75,360	107,485	82,656	99,115
State Total	216,710	436,030	267,180	413,334	296,628	368,879

Source: U.S. Census of Population, South Dakota, Number of Inhabitants.

Table B-10 - NONWHITE POPULATION

Economic Subarea	1950		1960		1970	
	Total Nonwhite	Total Indian	Total Nonwhite	Total Indian	Total Nonwhite	Total Indian
	Number					
Subarea 01	1,798	1,598	3,679	2,768	5,070	3,368
Subarea 02	3,362	3,343	3,720	3,701	4,021	3,971
Subarea 03	1,495	1,476	1,917	1,897	2,063	2,046
Subarea 04	10,931	10,877	10,284	10,252	15,040	14,975
Basin Total	17,586	17,294	19,600	18,618	26,194	24,360
State Total	24,236	23,344	27,416	25,794	35,174	32,365

Source: U.S. Census of Population, South Dakota, General Population Characteristics.

Table B-11 -- POPULATION CHANGE AND NET MIGRATION TO AND FROM COUNTIES, 1960 TO 1970

Economic Subarea	Population 1970	Population 1960	% Change 1960-1970	Components of Change: Births to Resident Mothers	Components of Change: Deaths of Residents	Components of Change: Net Migration	Net Migration Rate
	Number	Number	Percent	Number	Number	Number	Percent
Subarea 01							
Butte	7,825	8,592	- 8.9	1,654	915	- 1,506	-17.5
Custer	4,698	4,906	- 4.2	864	549	- 523	-10.7
Fall River	7,505	10,688	-29.8	1,516	1,285	- 3,414	-31.9
Lawrence	17,453	17,075	+ 2.2	3,798	1,680	- 1,740	-10.2
Meade	17,020	12,044	+41.3	2,876	1,185	+ 3,285	+27.3
Pennington	59,349	58,195	+ 2.0	17,625	3,973	-12,498	-21.5
Total	113,850	111,500	+ 2.1	28,333	9,587	-16,396	-14.7
Subarea 02							
Corson	4,994	5,798	-13.9	1,621	551	- 1,874	-32.3
Dewey	5,170	5,257	- 1.7	1,584	477	- 1,194	-22.7
Harding	1,855	2,371	-21.8	397	203	- 710	-29.9
Perkins	4,769	5,977	-20.2	945	558	- 1,595	-26.7
Total	16,788	19,403	-15.6	4,547	1,789	- 5,373	-27.7
Subarea 03							
Haakon	2,802	3,303	-15.2	661	310	- 852	-25.8
Jackson	1,531	1,985	-22.9	449	217	- 686	-34.6
Jones	1,882	2,066	- 8.9	421	181	- 424	-20.5
Lyman	4,060	4,428	- 8.3	983	472	- 879	-19.9
Stanley	2,457	4,085	-39.9	844	241	- 2,231	-54.6
Ziebach	2,221	2,495	-11.0	690	192	- 772	-30.9
Total	14,953	18,362	-18.6	4,048	1,613	- 5,844	-31.8
Subarea 04							
Bennett	3,088	3,053	+ 1.1	867	285	- 547	-17.9
Gregory	6,710	7,399	- 9.3	1,340	822	- 1,207	-16.3
Mellette	2,420	2,664	- 9.2	684	278	- 650	-24.4
Shannon	8,198	6,000	+36.6	3,175	877	- 100	- 1.7
Todd	6,606	4,661	+41.7	1,825	562	+ 682	+14.6
Tripp	8,171	8,761	- 6.7	1,867	853	- 1,604	-18.3
Washabaugh	1,389	1,042	+33.3	389	122	+ 80	+ 7.7
Total	36,582	33,580	+11.2	10,147	3,799	- 3,346	-10.0
Grand Total	182,183	182,845	- 0.004	47,075	16,788	-30,959	-16.9
State	666,257	680,514	- 2.1	143,495	65,192	-92,560	-13.6

Source: "South Dakota Population and Net Migration 1960-1970", South Dakota Agricultural Experiment Station Bulletin 580, February 1971.

Population and employment projections for the study area and the state under OBERS Series "C" and Series "E" assumptions appear in Table B-12. The projected data for the study area is graphically displayed in Figure B-12 along with the historic trend in total basins population.

Agricultural Sector

The number of farm operators within six age groups as of census years lying between 1959 and 1974 appears in Table B-13. Data are listed by economic subarea, basins totals and state totals. There has been a gradual decline of about 16 percent in total number of farm operators in the basins between 1959 and 1974. Numbers of farm operators in the state have likewise declined but by about 24 percent over the 20-year period. The age group of 45 to 54 years includes the greatest number of operators in each of the four census years, followed closely by the 35 to 44 years and 55 to 64 years age groups. Farm operators under 25 years of age are the least numerous in both the basins and the state in each census year. The average age of operators during those same census years is shown in Table B-14. Average age of operators within the study area is about one year more than the state average during the four census years. Operators in subarea 01 consistently average older in age than their counterparts in other subareas or the state.

The number of farm operators engaging in off-farm work during the census years lying between 1954 and 1974 appears in Table B-15.

A considerably greater number of operators work off the farm more than 200 days annually than the number who work more than 100 days. This holds true for both the study area and the state. Extent of off-farm work is greatest in subareas 01 and 04 and generally is least among census years in subarea 03.

Number and average size of all farms during a 20-year period is listed in Table B-16 by subarea, for the basins total and for the state total. Number of farms in the basins have shown a decline in each census year to the extent of about a 25 percent reduction over the 20-year period. Average size has increased steadily over that time to the extent of about 30 percent. The trend is consistent for each of the subareas although the magnitude varies. Numbers of farms and acres operated by full owners in the study area steadily increased until 1969 (Table B-17). Numbers of farms operated by full owners in 1974 showed a continued increase but the acreage fell back significantly. The general trend in subareas 02, 03 and 04 over time was increases in both number of owner-operated farms and number of acres. Subarea 01 showed a decline in number of operators but consistent increases in number of acres.

Table B-12 - POPULATION AND EMPLOYMENT PROJECTIONS

	1970		1985		2000		2020	
	Pop.	Emp.	Pop.	Emp.	Pop.	Emp.	Pop.	Emp.
Western South Dakota	181,771	69,073						
OBERS Series "C" (2.8)1/	-	-	175,099	66,538	199,679	77,875	215,897	86,359
OBERS Series "E" (2.1)1/	-	-	164,963	67,635	161,416	69,409	160,225	68,897
State of South Dakota	665,507	252,893						
OBERS Series "C" (2.8)1/	-	-	691,000	262,580	788,000	307,200	852,000	340,800
OBERS Series "E" (2.1)1/	-	-	651,000	266,910	637,000	273,910	632,300	271,889

1/ Corresponding fertility rate (per woman).

Figure B-12. Population, Historic and Projected Western South Dakota River Basins

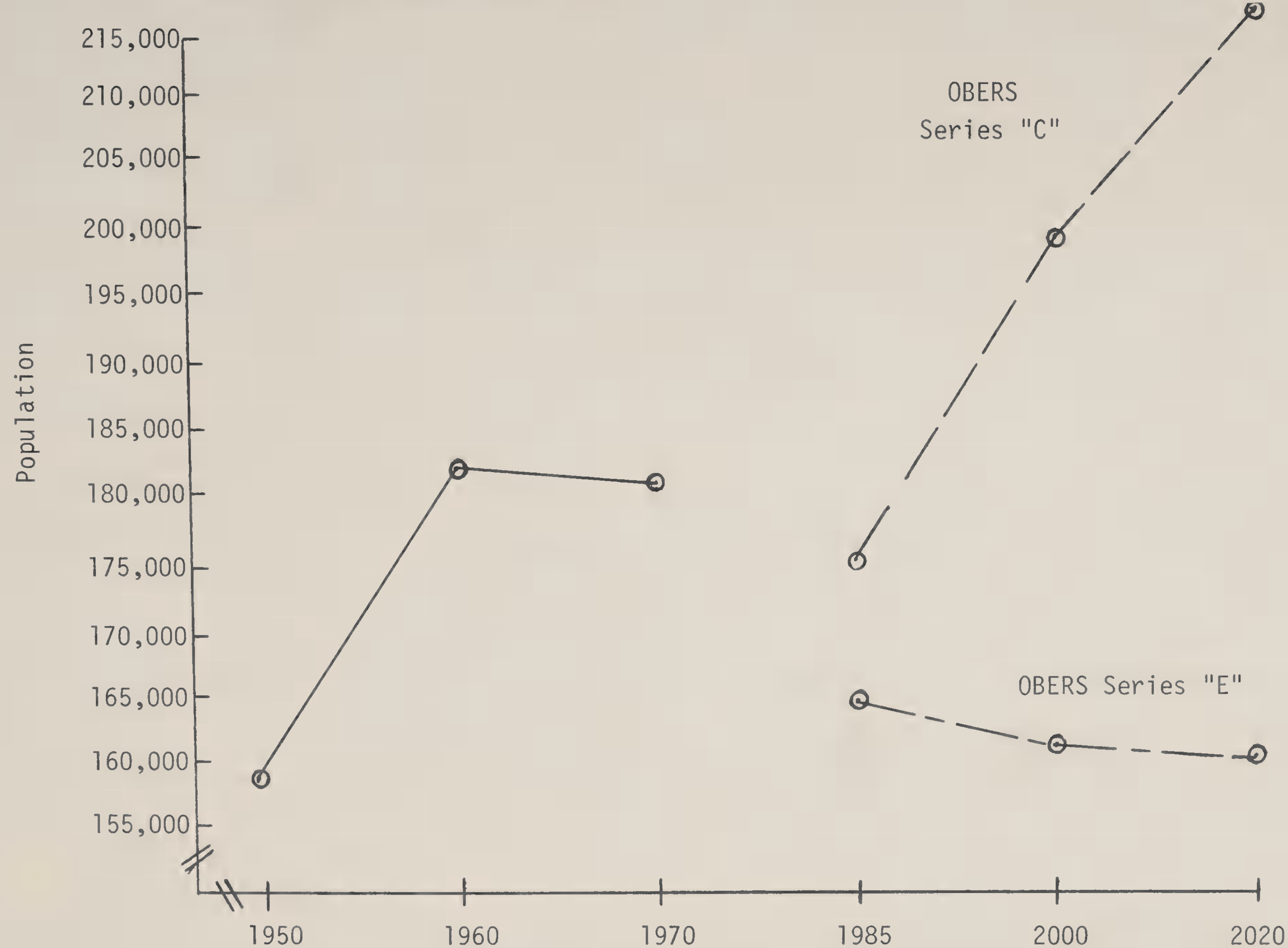


Table B-13 -- NUMBER OF FARM OPERATORS BY AGE GROUP

Census: Year	Economic Subarea	Under 25 Yrs.	25 to 34 Yrs.	35 to 44 Yrs.	45 to 54 Yrs.	55 to 64 Yrs.	65 Yrs. & Over	Basin Total	State Total
1959	1	47	374	751	850	600	501		
	2	36	375	575	564	386	265		
	3	32	282	459	493	359	244		
	4	60	493	833	841	665	425		
Basin Total		175	1,524	2,618	2,748	2,010	1,435	10,510	
State Total		1,302	9,217	13,658	13,735	11,093	6,123		55,128
1964	1	29	284	679	826	646	479		
	2	18	252	510	623	403	230		
	3	39	215	416	487	380	218		
	4	41	406	718	843	684	394		
Basin Total		127	1,157	2,323	2,779	2,113	1,321	9,820	
State Total		1,081	6,578	12,221	13,224	10,583	6,016		49,703
1969	1	55	296	563	810	756	424		
	2	46	192	394	538	466	230		
	3	47	192	347	454	434	213		
	4	87	324	587	825	709	397		
Basin Total		235	1,004	1,891	2,627	2,365	1,264	9,386	
State Total		1,250	5,422	9,794	12,723	10,990	5,547		45,726
1974	1	52	253	440	724	632	533		
	2	46	175	324	484	531	321		
	3	59	139	258	415	403	321		
	4	101	240	478	682	704	518		
Basin Total		258	807	1,500	2,305	2,270	1,693	8,833	
State Total		1,642	4,879	7,416	11,556	10,551	6,180		42,224

Source: U.S. Census of Agriculture, South Dakota.

Table B-14 -- AVERAGE AGE OF FARM OPERATORS

Census Year	Economic Subarea 01	02	03	04	Basin Average	State Average
	Average Age					
1959	50.1	47.7	48.3	48.6	48.4	47.4
1964	51.2	48.9	49.0	49.7	49.8	48.6
1969	51.4	49.0	49.6	50.2	50.3	49.2
1974	52.4	49.7	52.1	51.9	52.1	50.1

Source: U.S. Census of Agriculture, South Dakota.

Table B-15 -- NUMBER OF FARM OPERATORS WORKING OFF THEIR FARMS

Census Year	Days Worked Off Farm	Economic Subarea				Basin Total	State Total
		01	02	03	04		
1954	> 100	618	157	200	263	1,238	4,338
	> 200	1,420	684	747	1,080	3,931	17,107
1959	> 100	586	257	253	349	1,445	5,430
	> 200	1,080	603	547	863	3,093	14,589
1964	> 100	590	219	218	329	1,356	5,270
	> 200	1,089	630	583	846	3,148	13,770
1969	> 100	789	308	308	434	1,839	7,580
	> 200	1,246	681	654	934	3,515	16,136
1974	> 100	558	218	216	372	1,364	5,865
	> 200	816	449	357	651	2,273	10,206

Source: U.S. Census of Agriculture, South Dakota.

Table B-16 -- NUMBER AND AVERAGE SIZE OF ALL FARMS

Economic Subarea	1954		1959		1964		1969		1974	
	Number	Average Size	Number	Average Size	Number	Average Size	Number	Average Size	Number	Average Size
		Acres		Acres		Acres		Acres		Acres
01	3,629	1,655	3,173	1,871	2,943	2,059	2,904	2,190	2,729	2,300
02	2,535	2,659	2,232	2,983	2,036	3,300	1,866	3,605	1,941	3,457
03	2,135	2,641	1,905	2,964	1,755	3,284	1,687	3,490	1,639	4,237
04	3,841	2,145	3,361	2,437	3,086	2,905	2,929	3,335	2,768	3,430
Basins Total	12,140	2,236	10,671	2,522	9,820	2,852	9,386	3,124	9,077	3,203
State Total	62,520	719	55,727	805	49,703	917	45,726	997	42,825	1,074

Source: South Dakota Census of Agriculture.

Table B-17 -- NUMBER OF FARMS AND NUMBER OF ACRES OPERATED BY FULL OWNERS

Census Year	Unit	Economic Subarea				Basin Total	State Total
		01	02	03	04		
1954	No. Farms	1,536	597	564	928	3,625	19,654
	No. Acres	1,158,095	624,442	585,632	469,348	2,837,513	7,446,575
1959	No. Farms	1,354	508	530	884	3,276	17,841
	No. Acres	1,253,448	683,384	557,942	488,394	2,983,168	7,604,623
1964	No. Farms	1,354	549	491	968	3,362	16,438
	No. Acres	1,291,760	739,980	719,970	826,401	3,578,171	7,974,650
1969	No. Farms	1,422	604	632	1,082	3,740	17,494
	No. Acres	1,366,668	1,553,526	2,034,140	2,966,149	7,920,483	12,961,981
1974	No. Farms	1,437	765	606	1,138	3,946	17,300
	No. Acres	1,849,013	1,555,601	1,059,903	1,563,007	6,027,524	11,198,137

Source: U.S. Census of Agriculture, South Dakota.

Similar data for part owners are listed in Table B-18. Basins totals for census years reveal a steady decline in numbers between 1954 and 1974. Acreages declined steadily until 1969 and rose significantly by 1974. However, the 1974 acreage operated by part owners was still less than the 1959 acreage. Numbers of part owners operating farms declined in all census years and within all economic subareas and the state. In general, acreage operated by part owners declined within subareas over time. Numbers of farms and acres operated by tenants are inventoried in Table B-19. Numbers of tenant operated farms declined sharply within the 20-year span, while associated acreages declined much more modestly. State totals show a steady decline in both numbers and acreages during the same period.

Farm expenditures for commercial fertilizer rose steadily between 1954 and 1974 within all subareas, the basins and the state (Table B-20). Tonnage of commercial fertilizers used during that same period are listed in Table B-21. Tonnage used and acreage on which it was applied increased manyfold between 1954 and 1974. Numbers of farms on which the material was applied also increased greatly. The most intensive and extensive use of fertilizers occurred in subareas 01 and 04 at all points in time.

Expenditures for hired farm labor increased over time in all subareas as well as in the basins and state totals (Table B-22). Farm cash outlay for machine hire, custom and contract work are seen to increase severalfold within subareas, the basins and the state (Table B-23).

Total farm value of all livestock and poultry is set forth in Table B-24 for the years 1966 through 1974. With the general exception of 1968 and 1969 farm value rose substantially over time within subareas, the basins and the state.

In the discussion of total earnings earlier in this appendix, the assumptions underlying OBERS Series "C" and Series "E" were briefly reviewed. More recently, two additional sets of assumptions find expression in the OBERS Series E' and Series E". Series E' represents the currently accepted levels of assumptions for application to major crops and livestock projections. Four years of additional data in the historical time series were used in developing the E' series. A revised functional relationship between per capita demand and real income levels was developed for each commodity. Long-run trends in the patterns of consumption are not expected to be altered materially by short-term shortages or by sharp increases in the prices of agricultural products relative to other consumer goods. Export projections were based on the assumption of continued growth in import demand by various countries. OBERS E' export levels assumed a fall from high levels of imports by foreign countries, rebuilding of stocks by importing countries and some speculators' demand. This brief sketch leaves out many important elements in the

Table B-18 -- NUMBER OF FARMS AND NUMBER OF ACRES OPERATED BY PART OWNERS

Census Year	Unit	Economic Subarea				Basin Total	State Total
		01	02	03	04		
1954	No. Farms	1,564	1,556	1,222	1,947	6,289	24,137
	No. Acres	4,454,535	3,848,980	4,761,264	4,069,606	17,124,385	28,213,681
1959	No. Farms	1,406	1,431	1,076	1,760	5,673	22,716
	No. Acres	4,327,857	3,716,512	4,809,356	4,086,693	16,940,418	28,607,820
1964	No. Farms	1,283	1,246	1,000	1,530	5,059	22,015
	No. Acres	4,379,170	3,657,110	4,401,060	2,703,105	15,140,445	27,806,300
1969	No. Farms	1,204	1,065	809	1,404	4,482	20,355
	No. Acres	4,598,916	3,086,591	3,988,465	2,813,580	14,487,552	27,687,372
1974	No. Farms	1,052	935	775	1,294	4,056	19,182
	No. Acres	3,879,001	3,275,828	4,963,243	4,205,872	16,323,944	30,154,801

Source: U.S. Census of Agriculture, South Dakota.

Table B-19 -- NUMBER OF FARMS AND NUMBER OF ACRES OPERATED BY TENANTS

Census Year	Unit	Economic Subarea				Basin Total	State Total
		01	02	03	04		
1954	No. Farms	507	362	329	948	2,146	18,536
	No. Acres	563,804	546,612	543,667	901,779	2,555,862	8,220,418
1959	No. Farms	378	276	282	694	1,630	14,962
	No. Acres	529,209	507,672	567,713	803,603	2,408,197	7,394,284
1964	No. Farms	281	214	241	565	1,301	10,985
	No. Acres	423,529	435,968	424,773	543,402	1,827,672	5,839,250
1969	No. Farms	278	197	246	443	1,164	7,877
	No. Acres	692,724	299,152	695,638	457,649	2,145,163	4,934,811
1974	No. Farms	240	241	258	336	1,075	6,343
	No. Acres	916,038	309,855	735,052	339,319	2,300,264	4,624,838

Source: U.S. Census of Agriculture, South Dakota.

Table B-20 -- FARM EXPENDITURES: COMMERCIAL FERTILIZER

Economic Subarea	Commercial Fertilizer[1/] 1954	1964	1969	1974
	Dollars			
01	120,979	192,669	536,628	1,521,000
02	4,601	78,024	415,183	1,276,000
03	9,204	48,076	257,433	1,058,000
04	45,021	313,852	669,834	2,049,000
Basin Total	179,805	632,621	1,879,078	5,904,000
State Total	3,217,413	8,920,950	21,556,561	60,664,000

1/ 1959 data not available.
Source: U.S. Census of Agriculture.

Table B-21 -- USE OF COMMERCIAL FERTILIZER, 1959-1974

Economic Subarea	1959			1964			1969			1974		
	No. of: Farms	No. of: Acres	Tons Used	No. of: Farms	No. of Acres	Tons Used	No. of: Farms	No. of Acres	Tons Used	No. of: Farms	No. of Acres	Tons Used
01	260	13,761	1,471	310	21,946	2,010	566	76,475	5,311	647	111,640	7,713
02	70	8,690	219	174	30,805	898	505	129,611	4,591	482	140,199	6,099
03	11	1,082	44	92	8,594	558	215	42,066	2,411	299	76,360	5,361
04	208	17,792	803	658	64,472	3,484	724	105,025	6,921	841	166,878	10,953
Basin Total	549	41,325	2,537	1,234	125,817	6,950	2,010	353,177	19,234	2,269	495,077	30,126
State Total	10,511	781,515	43,341	16,137	1,716,633	100,285	19,584	3,473,177	234,164	21,976	4,917,458	335,347

Source: U.S. Census of Agriculture.

Table B-22 -- FARM EXPENDITURES: HIRED FARM LABOR

Economic Subarea	Hired Farm Labor 1959	1964	1969	1974
	Thousands of Dollars			
01	1,579	1,717	2,515	3,179
02	1,057	1,241	1,623	2,134
03	1,238	1,392	1,731	2,878
04	1,787	2,025	2,338	3,142
Basin Total	5,660	6,375	8,207	11,333
State Total	17,126	20,021	27,513	38,333

Source: U.S. Census of Agriculture.

Table B-23 -- FARM EXPENDITURES: MACHINE HIRE, CUSTOM AND CONTRACT WORK

Economic Subarea	Machine Hire, Custom and Contract Work			
	1959	1964	1969	1974
	Thousands of Dollars			
01	621	910	1,381	1,996
02	566	965	1,485	2,107
03	658	1,287	1,816	3,495
04	862	1,223	1,603	2,588
Basin Total	2,706	4,385	6,285	10,186
State Total	9,427	14,725	24,898	38,343

Source: U.S. Census of Agriculture.

Table B-24 - TOTAL FARM VALUE OF ALL LIVESTOCK AND POULTRY,1/ 1966-1974

Year	Economic Subarea				Basin	State
	01	02	03	04	Total	Total
	Thousands Dollars					
1966	57,861.3	46,363.3	47,401.9	69,136.5	220,763.0	722,611.0
1967	60,021.4	50,406.5	52,093.3	75,348.4	237,869.6	776,931.0
1968	58,510.2	47,703.5	49,613.1	72,905.7	228,732.5	751,908.0
1969	63,732.3	49,763.8	55,741.7	79,804.1	249,042.3	817,562.0
1970	71,569.3	57,624.3	63,771.5	91,152.5	284,117.6	945,362.0
1971	72,541.1	56,786.7	65,663.4	92,868.9	287,859.1	936,526.0
1972	87,655.2	65,479.7	72,170.2	106,444.4	331,749.5	1,055,582.0
1973	113,899.3	84,985.9	92,941.6	136,623.7	428,450.5	1,350,290.0
1974	158,975.3	118,610.0	131,213.3	197,729.1	606,527.9	1,926,966.0

1/ Chickens, all cattle, all hogs and all sheep.
Source: South Dakota Agricultural Statistics.

underlying assumptions, but it should be sufficient to perceive the broad base of assumptions on which projections of production of agricultural commodities are made.

Yet another set of assumptions have been developed in order to more comprehensively cover the array of possible futures and evaluate their consequences. OBERS Series E" projections were generated importantly on the basis of high export assumptions. The series plays a role in this appendix on the basis of the impact on levels of production that could occur if the assumptions came to pass. They are not predictions of future production patterns nor are they targets to be achieved by policies and programs.

Table B-25 shows the projected levels of production of major crops and livestock products in the study area under the assumptions of OBERS Series E' and E" projections. The projections have more meaning if they are displayed in relation to the historic production of the same commodities. Figures B-13 through B-25 graph the historic production and the OBERS Series E' projections. The projections represent a base from which alternative future policies and programs can be evaluated.

Forestry

Research indicates that the long-term reduction of mortality of ponderosa pine due to the mountain pine beetle can best be accomplished by maximizing the acreage of timber managed at a stocking level of 80 square feet of basal area per acre with intermediate cuts at least every 20 years in order to maximize the vigor of the stands (Sartwell, Charles, 1971; Wortendyke, John, 1968; USDA, Forest Service, 1975; Sartwell, Charles, and Robert E. Stevens, 1975; Sartwell, Charles, and Robert E. Dolph, Jr., 1976). This accomplishment must, of course, be consistent with other objectives for the forest. The ideal condition, considering the above, seems to be represented by the fully regulated, intensively managed forest.

Projections of treatment required to achieve the condition of reduced susceptibility to mountain pine beetle and a stable forest industry via the intensively managed regulated forest are presented in the following tables.

Total acreage treated over a 50-year period is 580,000 on state, private and Bureau of Land Management and 2,541,000 on national forests or a total of 3,121,000 acres.

Table B-25 -- OBERS AGRICULTURAL PRODUCTION PROJECTIONS

Crop	Unit	Future Time Frame				
		1985		2000		2020
		OBERS Series		OBERS Series		OBERS Series
		E'	E"	E'	E"	E'
Wheat	Bu. x 1,000	21,843.8	28,237.0	25,601.1	32,831.6	29,344.4
Rye	Bu. x 1,000	559.6	563.3	606.0	609.9	655.8
Corn/grain	Bu. x 1,000	3,610.6	4,129.4	3,671.0	3,662.0	3,727.0
Corn/silage	Tons x 1,000	498.3	-	506.6	-	514.6
Sorghum/grain	Bu. x 1,000	7,205.9	8,055.2	13,247.8	14,079.1	18,595.8
Sorghum/silage	Tons x 1,000	216.2	-	397.4	-	557.9
Oats	Bu. x 1,000	15,052.6	15,421.7	21,510.0	21,991.2	28,443.4
Barley	Bu. x 1,000	3,550.4	3,747.6	3,073.3	3,141.5	3,018.4
All hay	Tons x 1,000	1,910.7	1,954.7	2,278.9	2,332.6	2,639.6
Flaxseed	Bu. x 1,000	146.4	-	123.9	-	100.3
Beef & veal	Lbs. x 1,000	750,744.8	775,215.0	904,233.7	932,740.4	1,031,686.2
Pork	Lbs. x 1,000	88,484.5	-	114,343.6	-	142,690.6
Mutton	Lbs. x 1,000	14,217.9	14,218.1	14,393.3	14,393.5	20,102.6
Eggs	Doz. x 1,000	5,664.4	5,664.8	5,500.2	5,500.2	5,206.6
Milk	Lbs. x 10^6	181.2	-	175.2	-	181.3

Figure B-13. Historic and Projected (All) Wheat Production
Western South Dakota River Basins

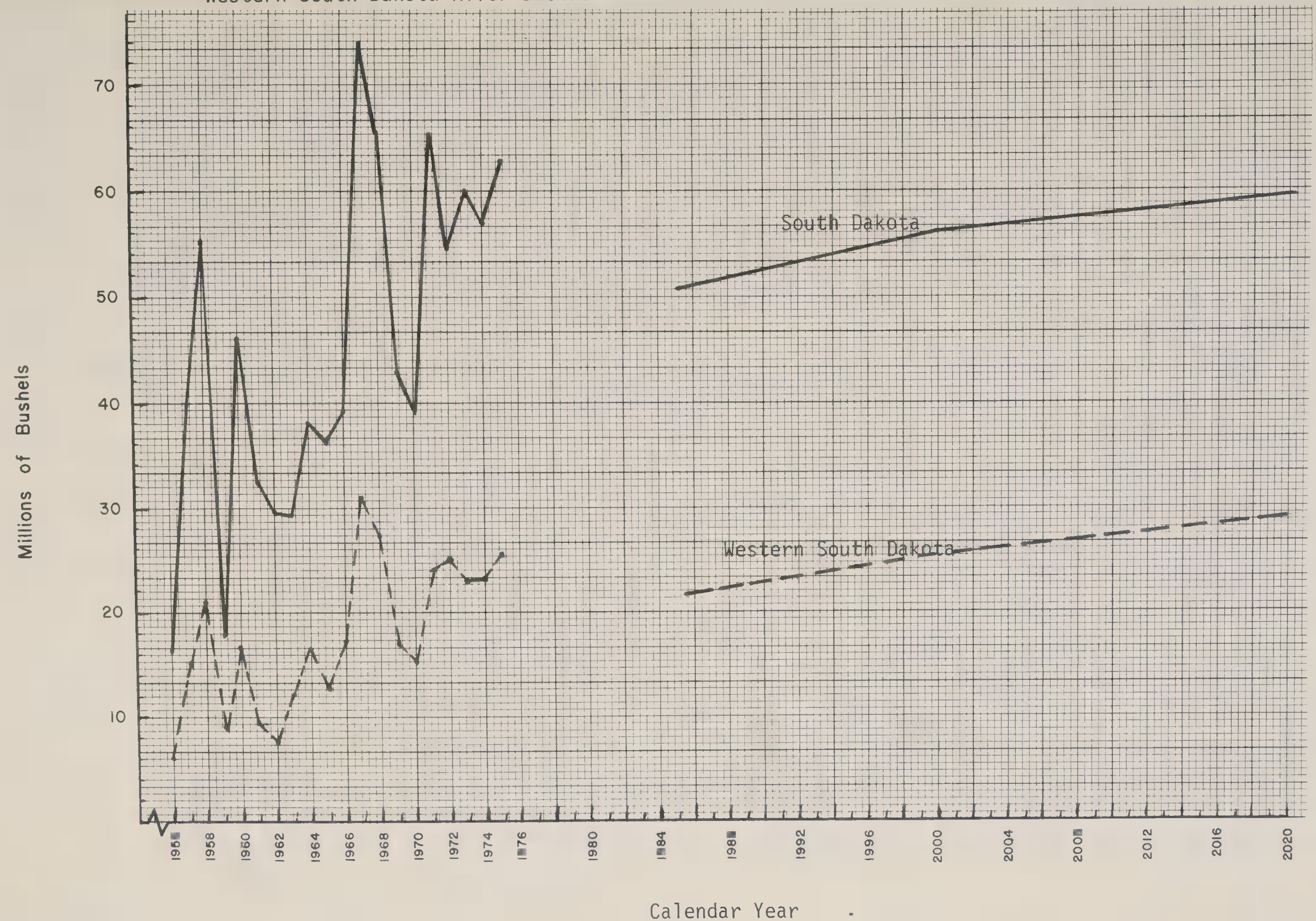


Figure B-14. Historic and Projected Rye Production
Western South Dakota River Basins

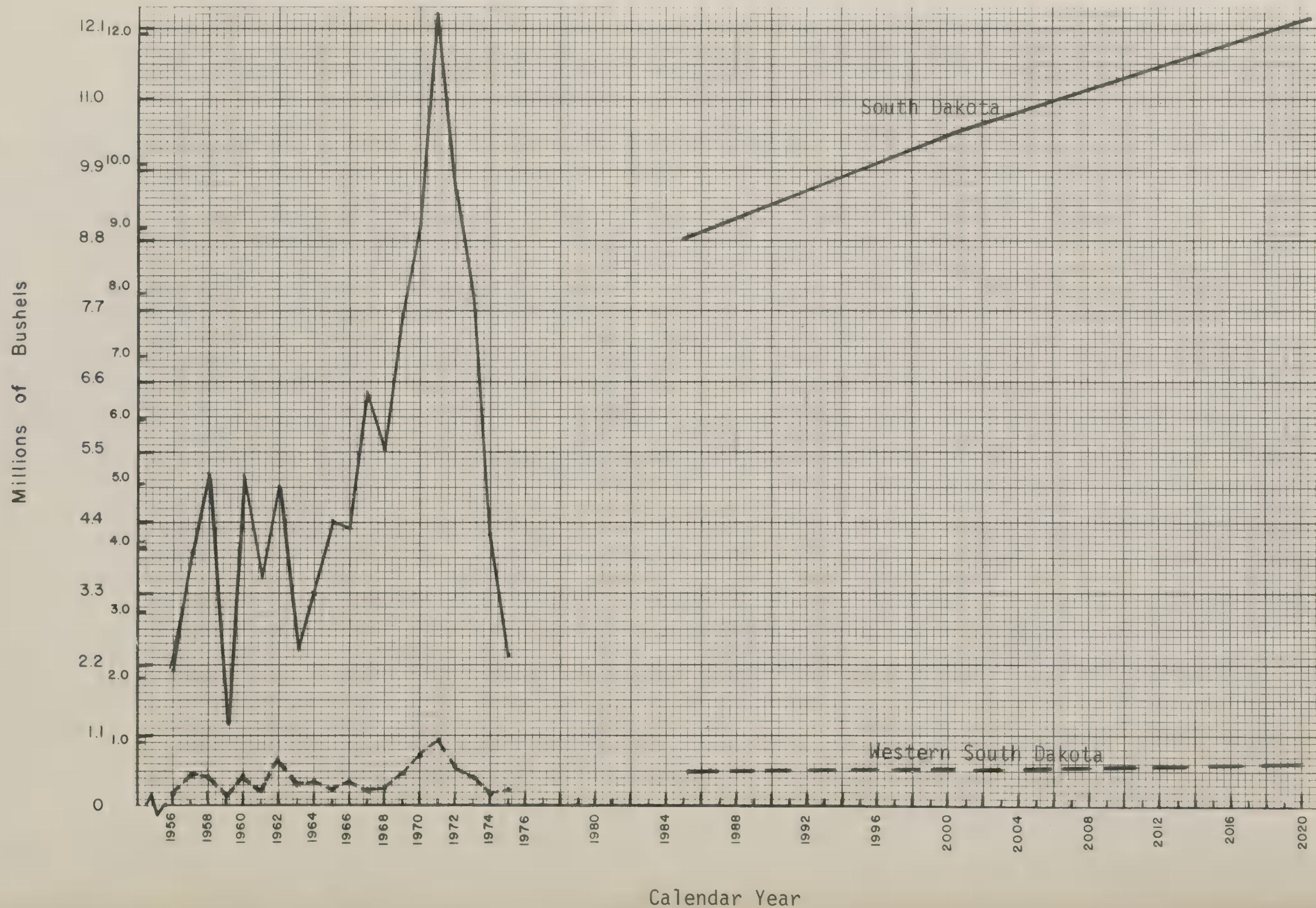


Figure B-15. Historic and Projected Corn/Grain Production Western South Dakota River Basins

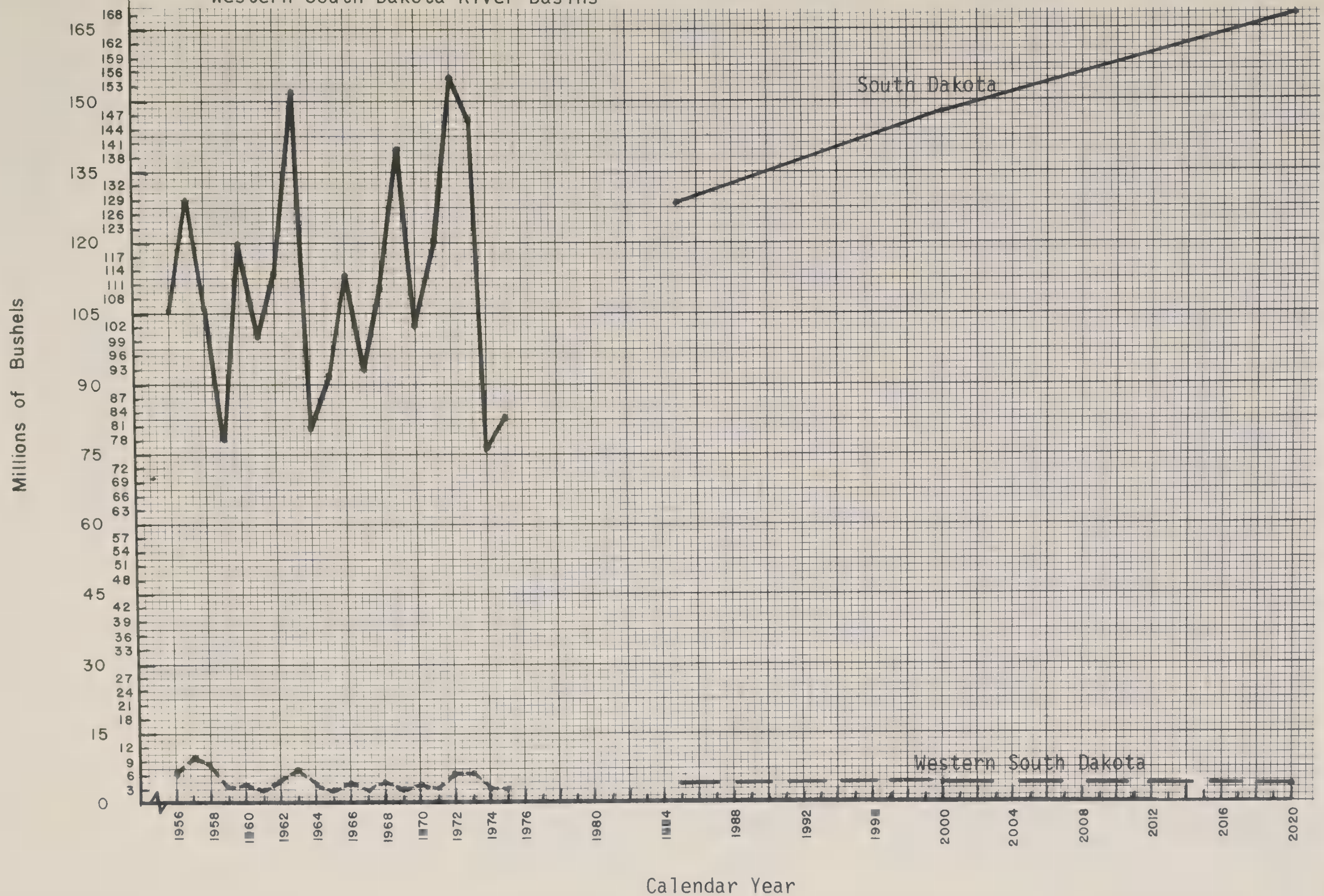


Figure B-16. Historic and Projected Sorghum/Grain Production Western South Dakota River Basins

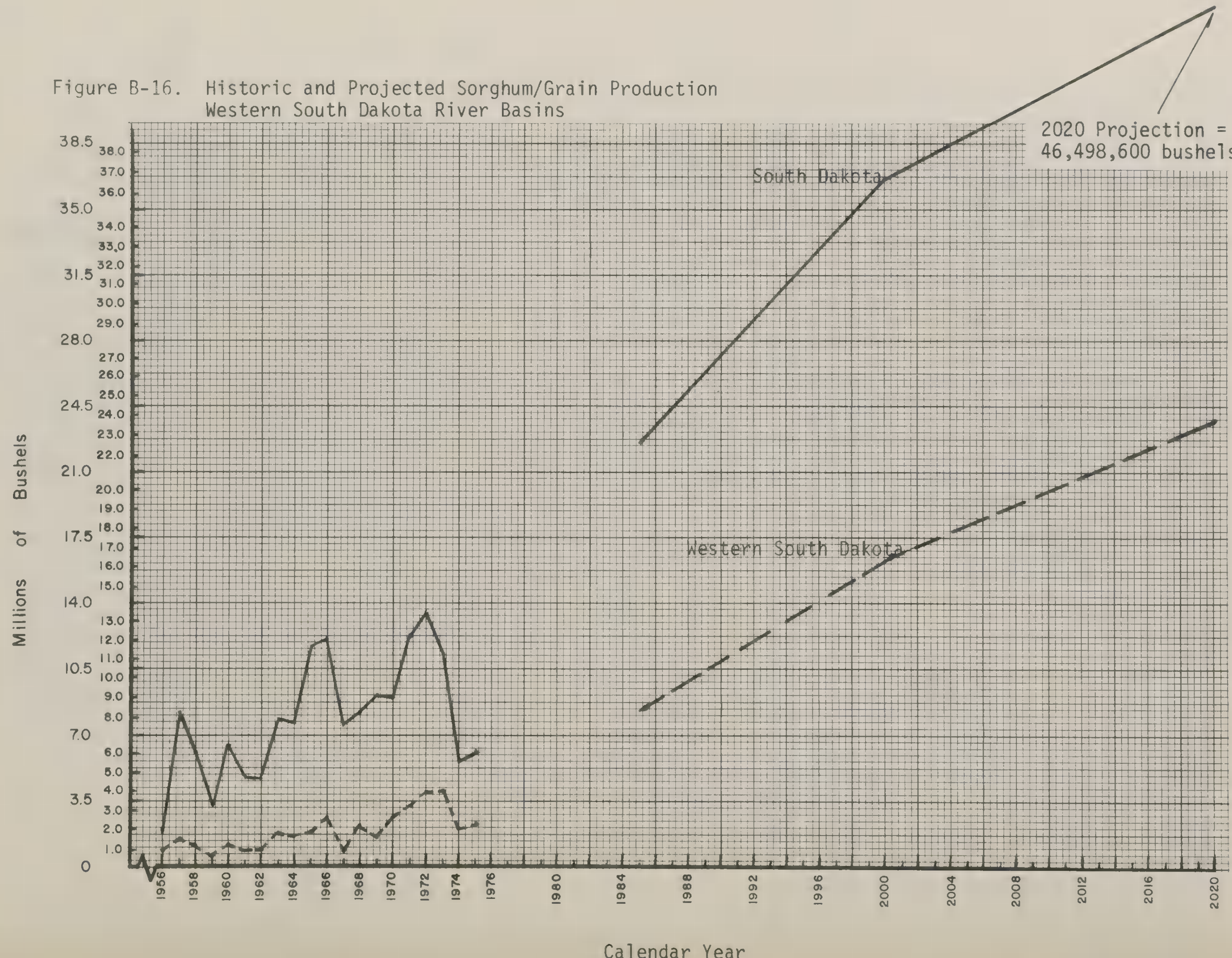


Figure B-17. Historic and Projected (All) Oats Production
Western South Dakota River Basins

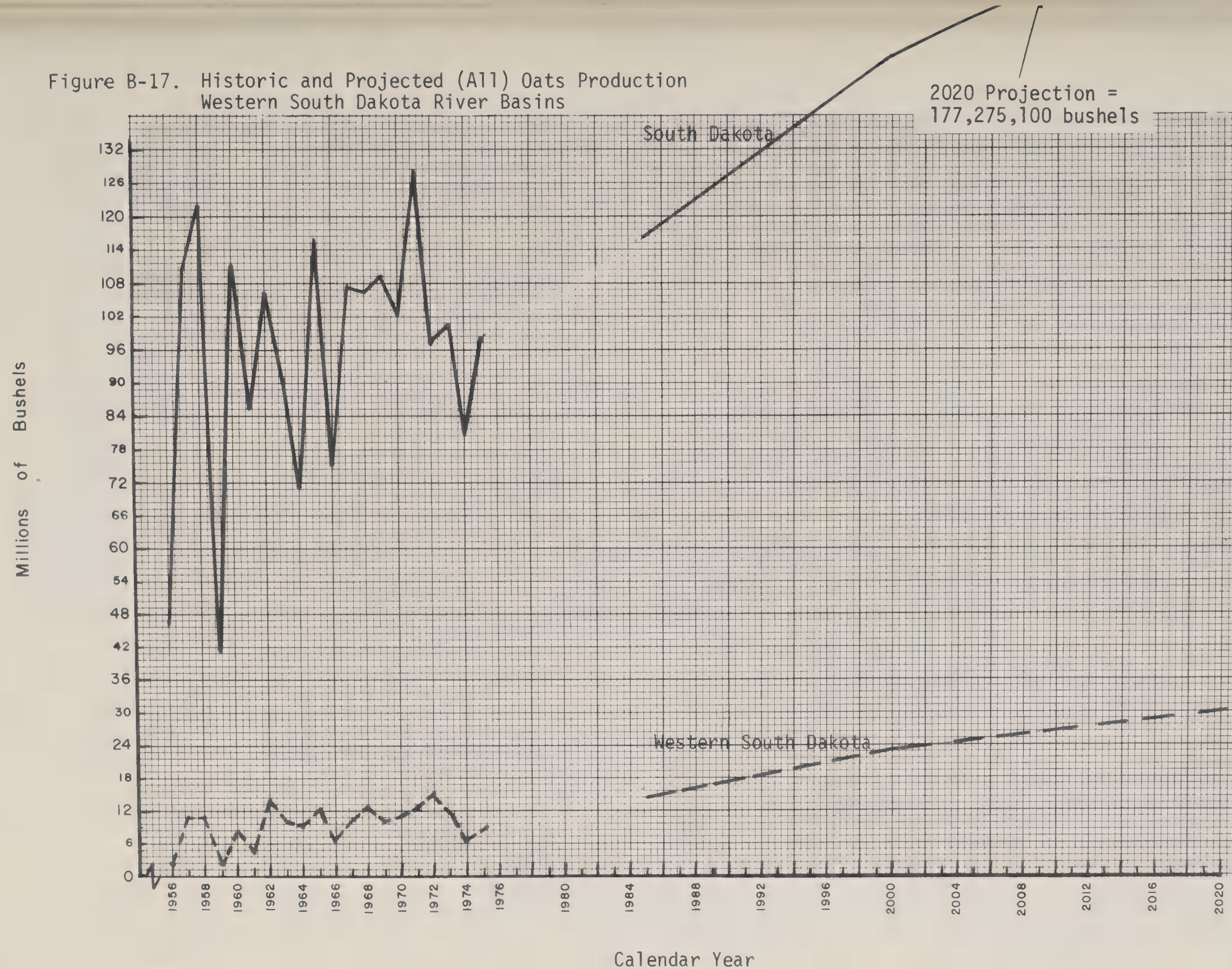


Figure B-18. Historic and Projected Barley Production
Western South Dakota River Basins

Figure B-19. Historic and Projected All Hay Production
Western South Dakota River Basins

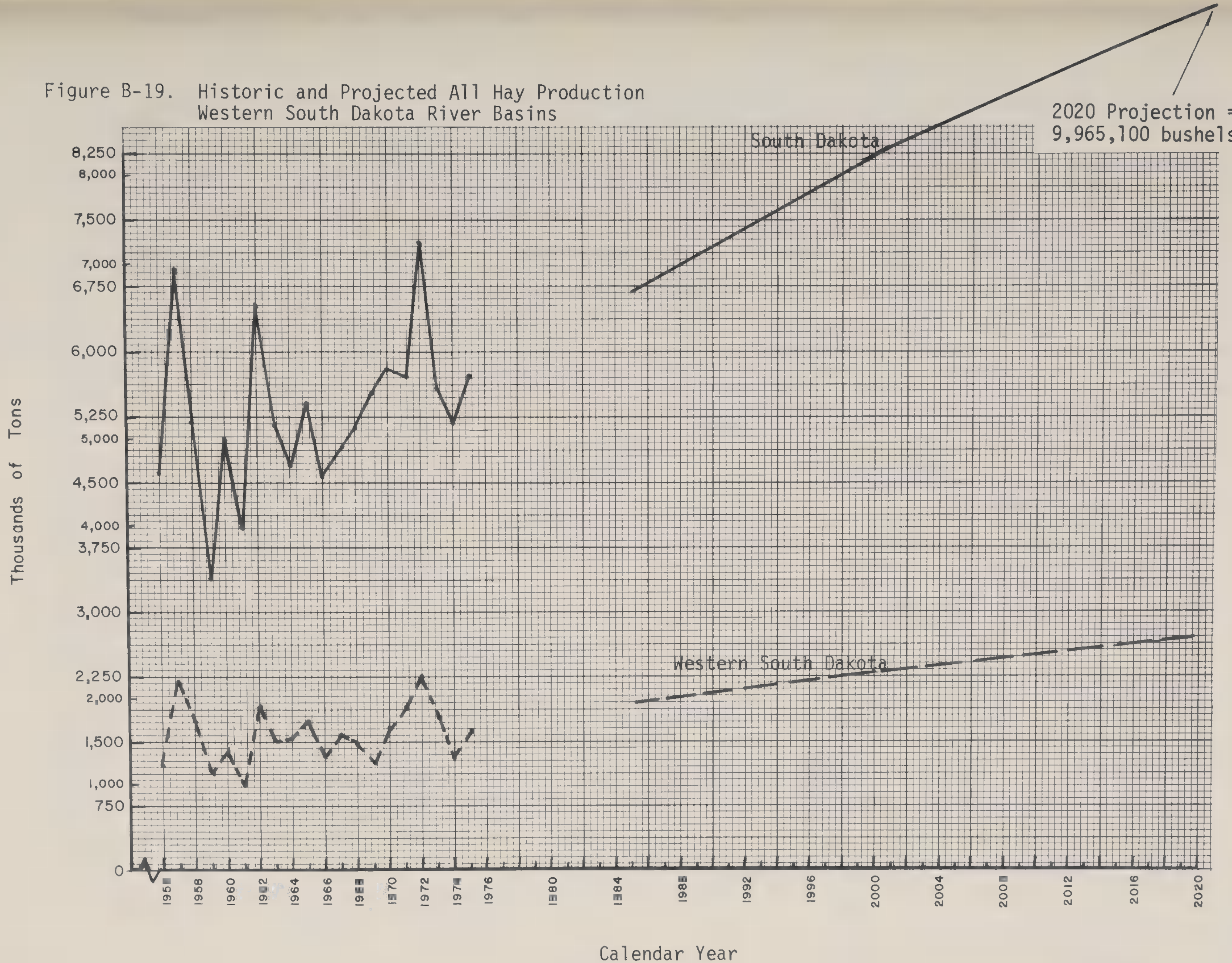


Figure B-20. Historic and Projected Flaxseed Production
Western South Dakota River Basins

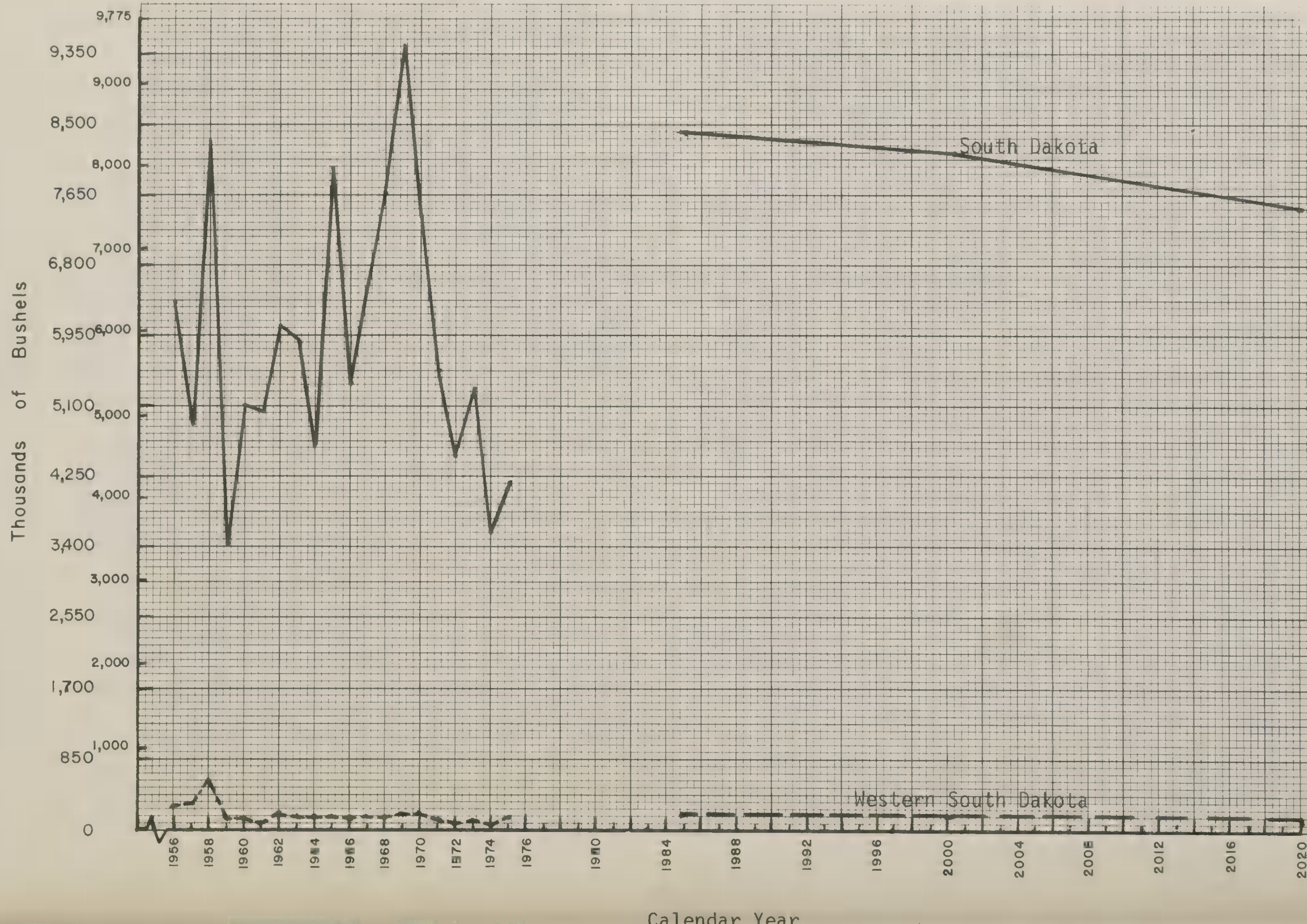


Figure B-21. Historic and Projected Net Production of Beef and Veal
Western South Dakota River Basins

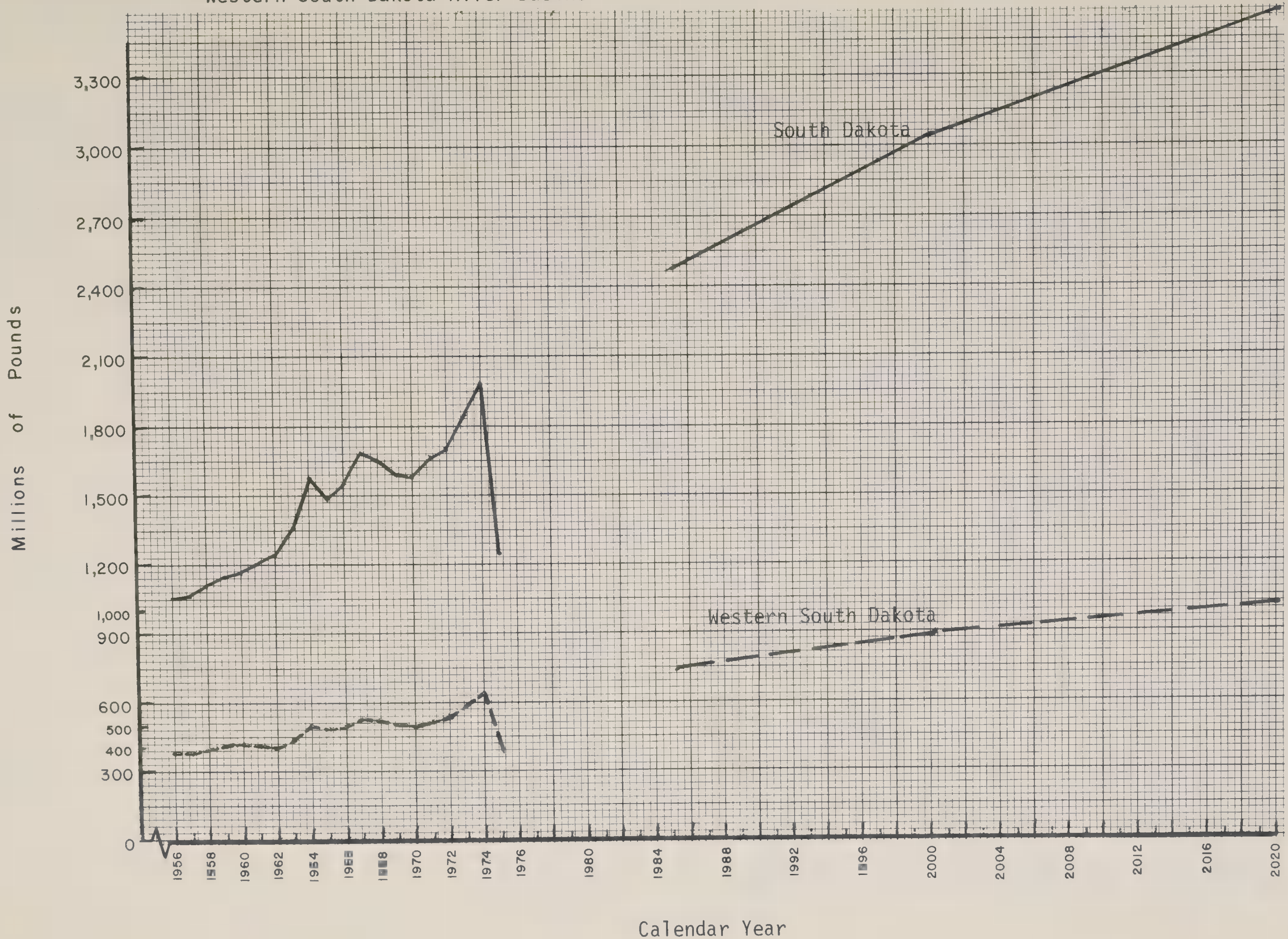


Figure B-22. Historic and Projected Net Production of Pork Western South Dakota River Basins

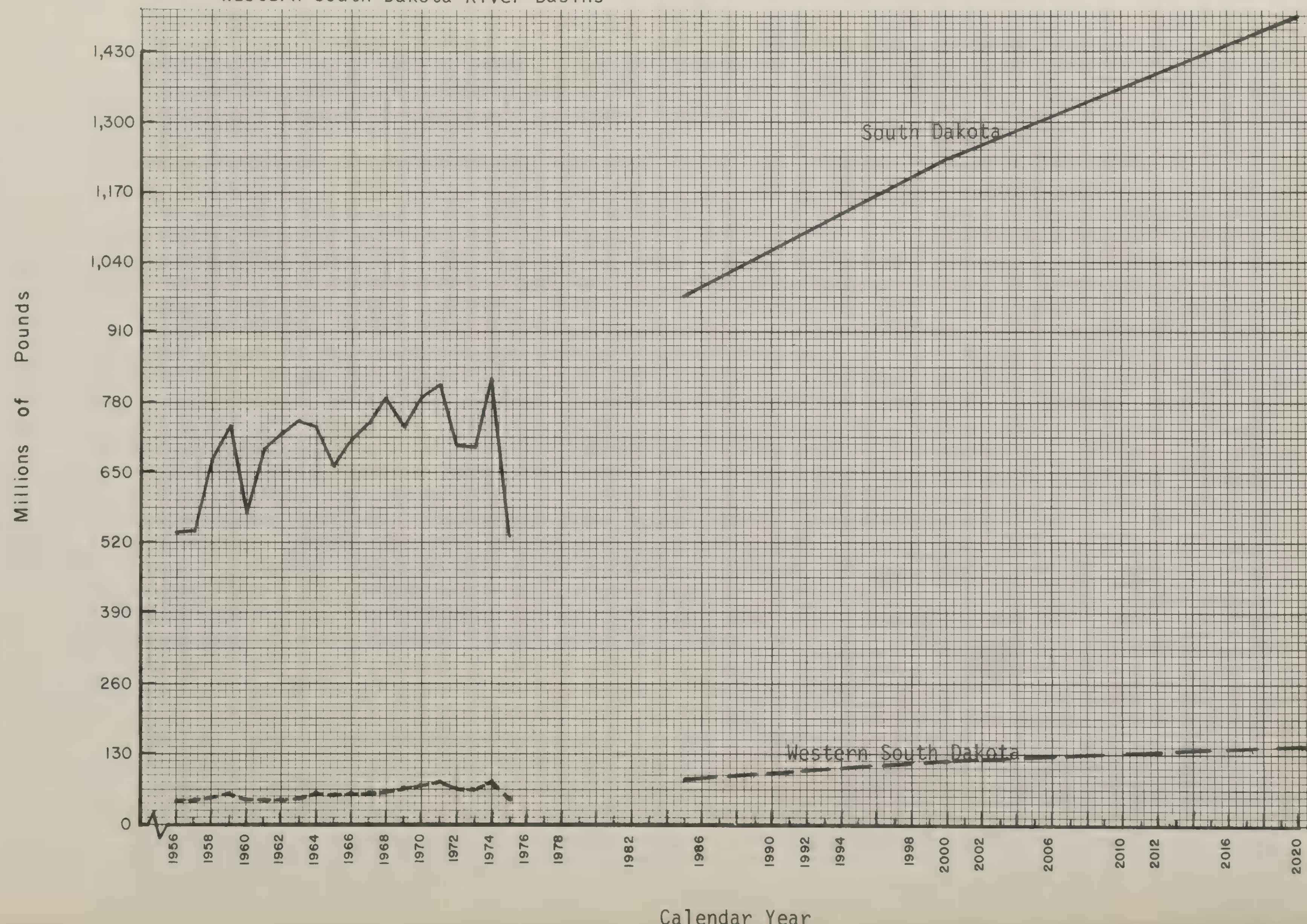


Figure B-23. Historic and Projected Net Production of Mutton Western South Dakota River Basins

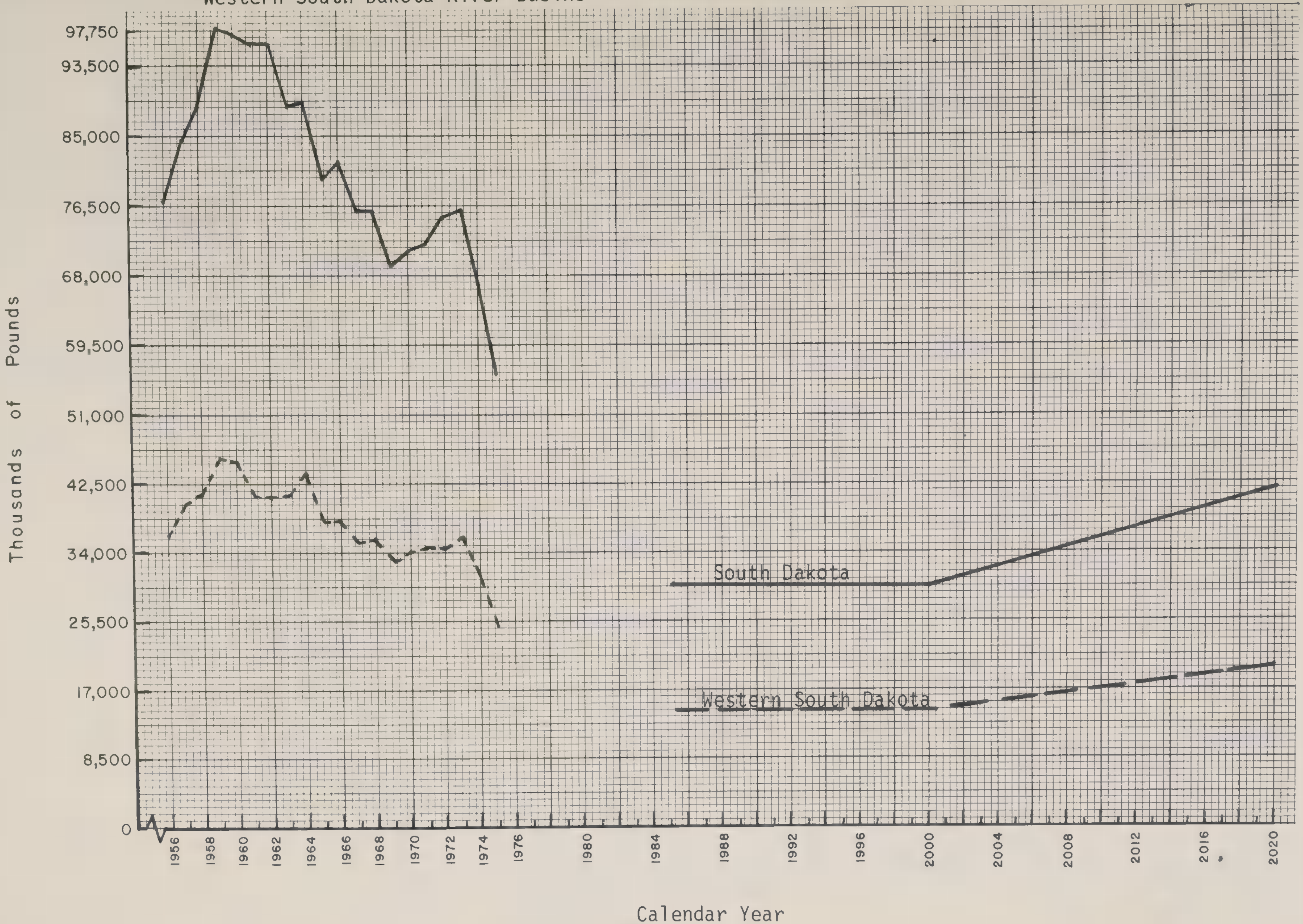


Figure B-24. Historic and Projected Egg Production
Western South Dakota River Basins

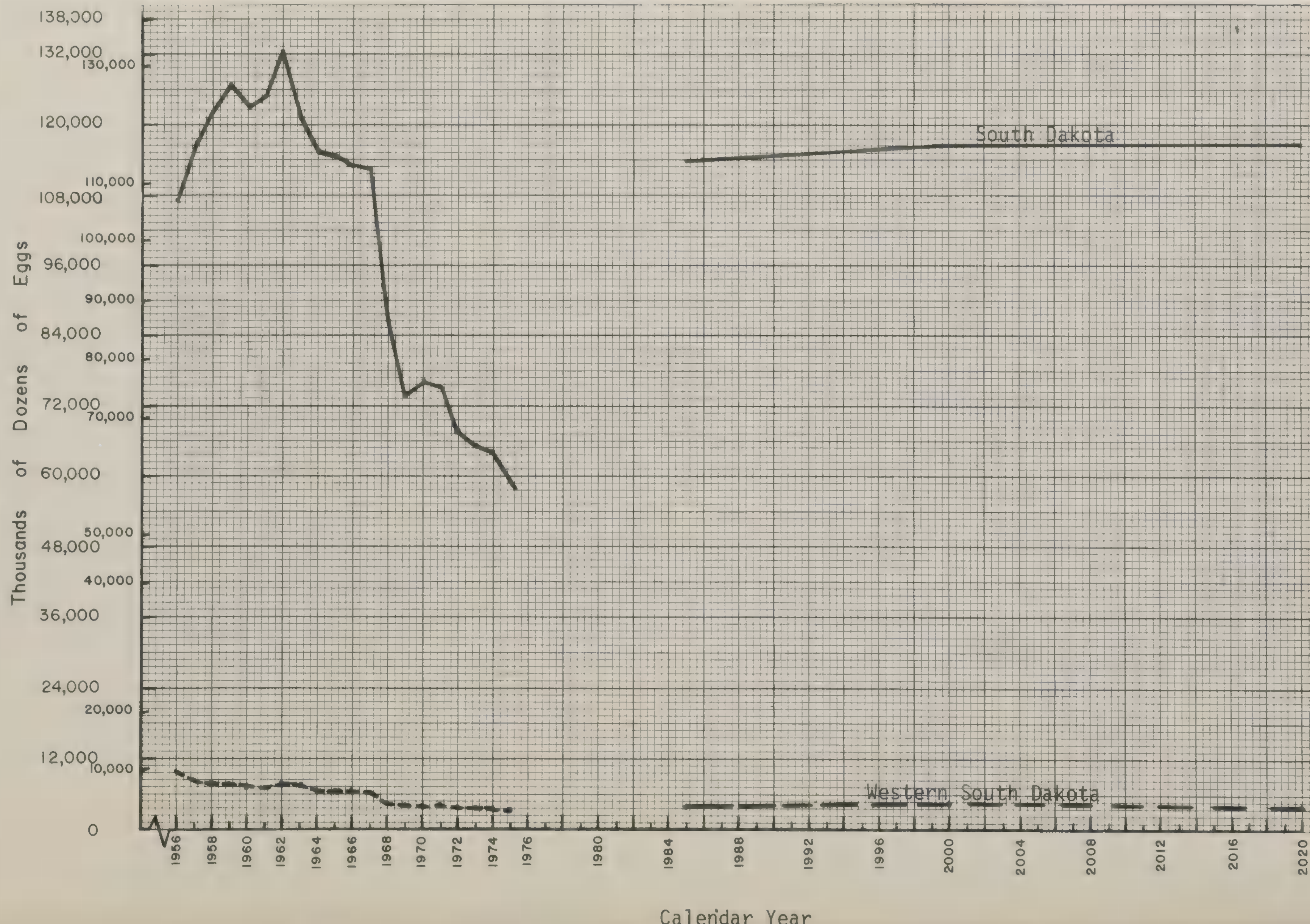
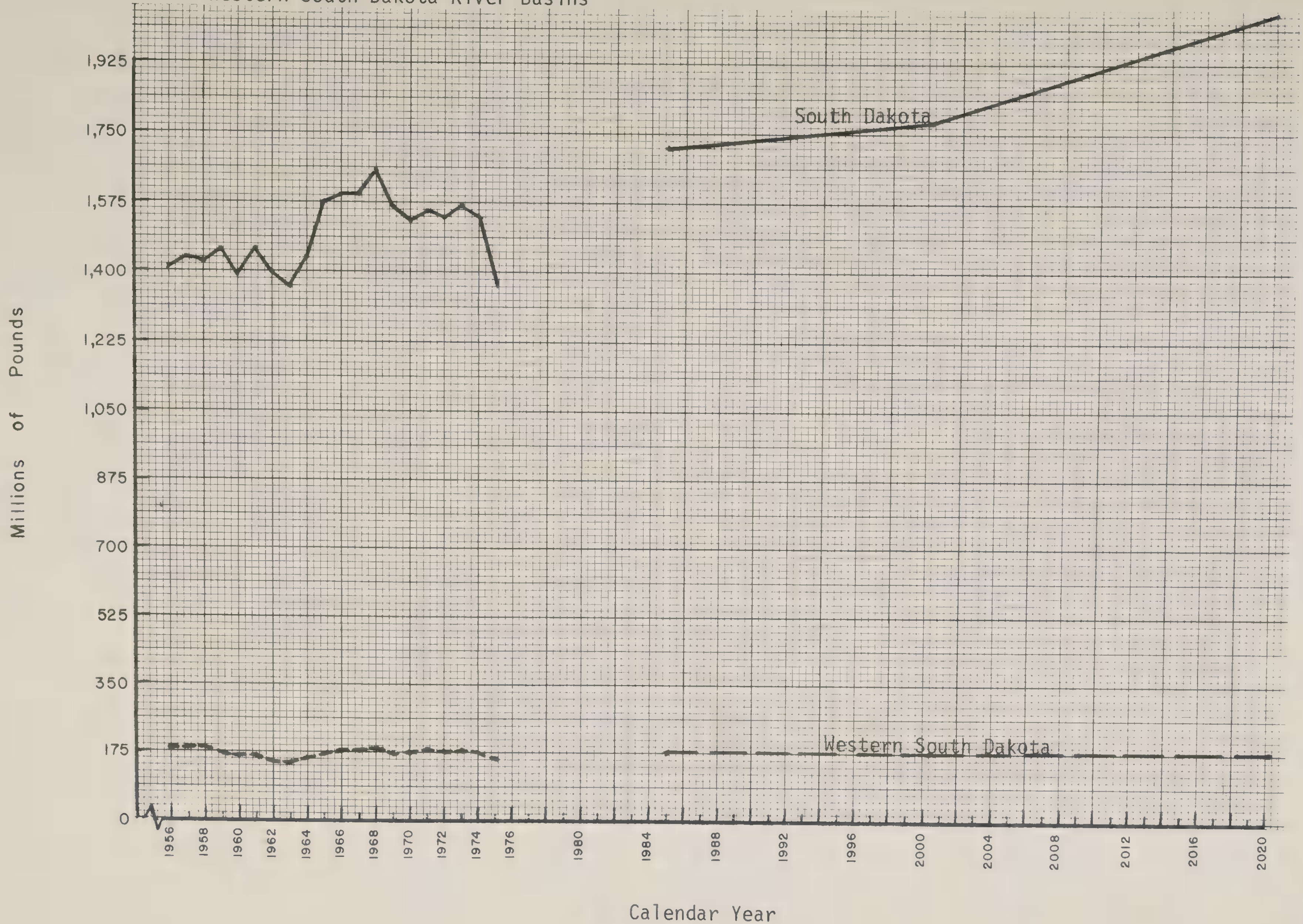


Figure B-25. Historic and Projected Milk Production
Western South Dakota River Basins



Acres of Annual Silvicultural Treatment by Decade
(Harvest and Intermediate Cuts Only - No Salvage)

Decade	Private and BLM	National Forest	Total
1977-1986	10,500	39,600	50,100
1987-1996	10,700	61,900	72,600
1997-2006	11,000	42,900	53,900
2007-2016	12,900	54,000	66,900
2017-2036	12,900	55,700	68,600

Because tourism is an important industry in the Black Hills, aesthetics is an important quality of the forest. Dying ponderosa pine trees with red foliage are not generally accepted as a desirable component of the scenery. Other effects of the mountain pine beetle which are accepted as desirable components are the irregular openings created and the irregular density of the forest cover and creation of diverse habitat for wildlife.

Environmental preference is to have large enough populations of all endangered and threatened species to insure their survival. As more is learned about the habitat and life cycle requirements of these animals, statements of environmental preference can be more specific.

It is estimated that the Black Hills deer herd numbered over 100,000 around 1950, and that the herd was larger than the winter range could support continuously. As burns such as the McVey Burn of 1939 have been reforested and as timber stands in general grew more dense, the capacity to support deer during the winter months declines. The winter range capacity and the herd have declined to about 65,000 deer in 1975. At this rate, by the year 2000 the herd would be diminished to 30,000 deer.

Environmental preference is to return the herd to near its former size consistent with the winter range carrying capacity. It is estimated that a herd size of 90,000 deer could be sustained.

Although the production of forest products is not a problem in terms of meeting demand, the following table presents the estimated demand for comparison with estimated production of the alternative plans.

Basin's Share of National Demand[1/]

	1980	1990	2000	2010	2020
Roundwood (1,000 ft.)	21,840	25,250	20,660	36,300	40,600
Sawtimber (1,000 ft.)	14,400	16,300	19,300	22,300	24,400

1/ Projected by the adjusted standardized normalized modification of OBERS E projections of historically unadjusted national demand.

DETAILED DESCRIPTION
OF
THE ANALYTICAL SYSTEM

APPENDIX C

Detailed Description of the Analytical System

This appendix deals with the detail of the systems as well as the presentation of selected input data. The remaining elements of data input appear in other appendices either because of being most appropriately placed there or simply because of bulk. Appendices E, F and G are of considerable volume and are expected to be in limited demand. Therefore, they are not attached to this report but are available upon request.

Figure C-1 illustrates the general flow of the systems and will serve as a point of reference for this section. Wherever data relevant to this flow appears in another appendix or in the body of the report, it will be referenced. The systems flow depicted commences in the lower left corner of the figure and proceeds clockwise to near full circle.

Soil Resource Groups

Each group is an aggregate of soil mapping units identified in their presence and extent by the 1967 Conservation Needs Inventory (CNI). Aggregations into the 37 Soil Resource Groups (SRG's) are based on similarities in use, response to management, production and precipitation-evaporation relationships. Brief descriptions of the SRG's are listed below.

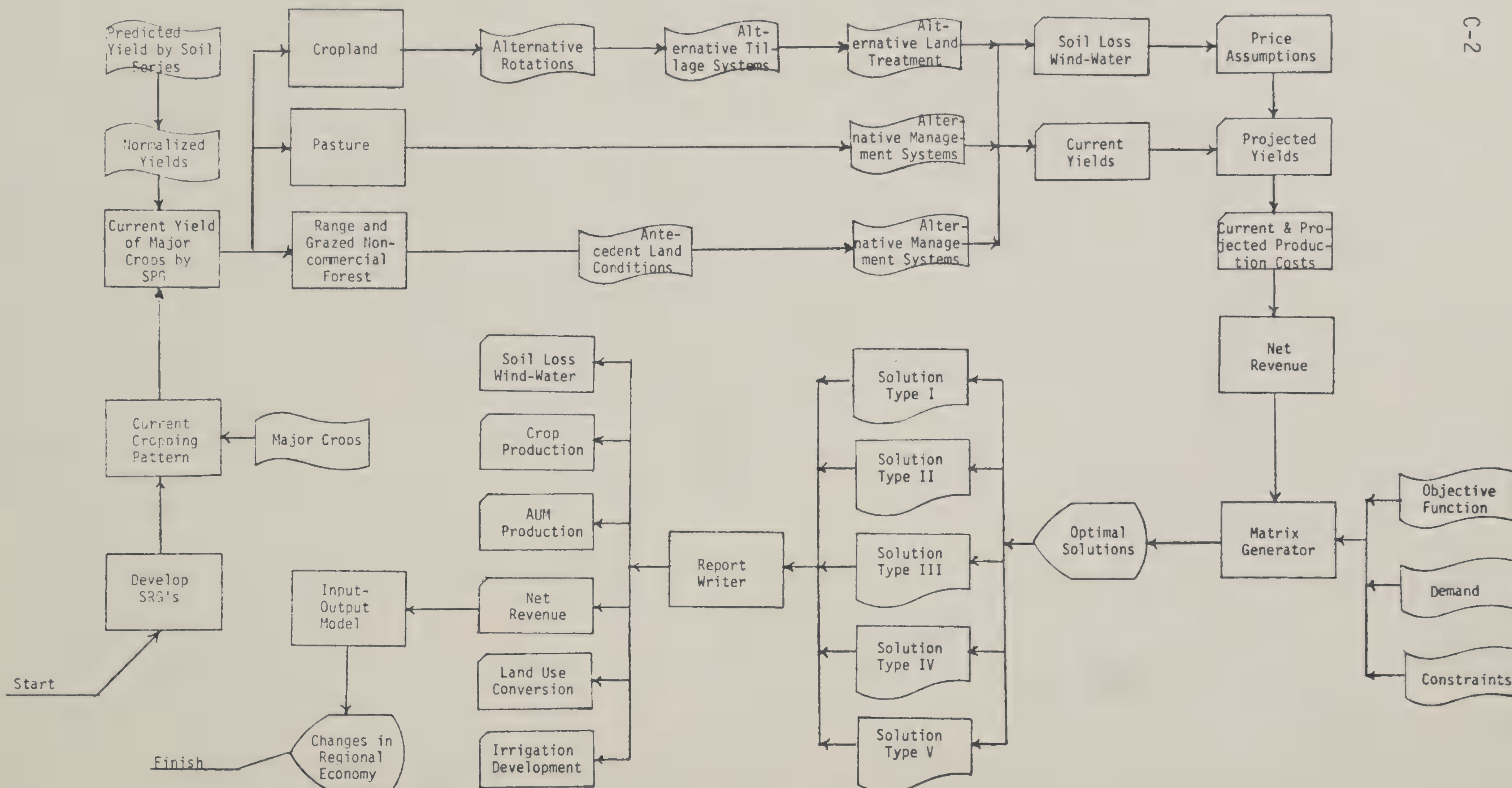
SRG 011 (PE 31-44)

Deep and moderately deep, well and moderately well drained, silty and loamy soils mainly on uplands. Slopes range from 0 to 2 percent. Permeability is moderate or moderately slow. Available water capacity is moderate or high. Moisture is inadequate in most years and these soils have a slight or moderate wind erosion hazard. Capability units represented are IIc1, IIc2, IIc3, IIs1, IIIe5, IIIs1 and IIIs6. Dominant soils are Arnegard, Belfield, Haverson, Keith, Morton, Ree, Reliance and Richfield.

SRG 022 (PE <31)

Same as SRG 011 except in PE <31. Capability units represented are IIIc1, IIIc2, IIIc3, IIIs2, IVe10 and IVs5. Dominant soils are Arnegard, Caputa, Haverson, Havre, Keith, Marmarth, Nunn and St. Onge.

Figure C-1 -- FLOW DIAGRAM OF ANALYTICAL SYSTEMS



SRG 031 (PE 31-44)

Deep and moderately deep, well drained, silty and loamy soils mainly on uplands. Slopes range from 2 to 6 percent. Permeability is moderate or moderately slow. Available water capacity is moderate or high. These soils have a moderate wind and water erosion hazard and an inadequate moisture supply in most years. Capability units represented are IIe1, IIe2, IIe3, IIIe3, IIIe11, IIIe12 and IVe2. Dominant soils are Arnegard, Belfield, Kadoka, Keith, Ree, Reliance, Regent and Richfield.

SRG 042 (PE <31)

Same as SRG 031 except in PE <31. Capability units represented are IIIe1, IIIe2, IV38, IVe9 and IVe11. Dominant soils are Arnegard, Belfield, Caputa, Kadoka, Keith, Nunn and Marmarth.

SRG 051 (PE 31-44)

Deep and moderately deep, well drained silty and loamy soils on uplands. Slopes range from 6 to 9 percent. Permeability is moderate or moderately slow. Available water capacity is moderate or high. These soils have a severe water and moderate wind erosion hazard and an inadequate moisture supply in most years. Capability units represented are IIIe1, IIIe2, IVe3 and IVe7. Dominant soils are Belfield, Kadoka and Morton.

SRG 062 (PE <31)

Same as for SRG 051 except in PE <31. Only capability unit IVe1 is represented. Dominant soils are Caputa, Kadoka, Keith, Marmarth, Ralph and Regent.

SRG 071 (PE 31-44)

Deep and moderately deep, well drained clayey soils mainly on uplands. Slopes range from 0 to 2 percent. Permeability is slow or very slow. Available water capacity is low or moderate. Water penetration, rooting and water uptake by plants is limited. These soils have a moderate or severe wind erosion hazard. Only capability unit IIIs3 is in this group. Dominant soils are Millboro, Promise and Opal.

SRG 082 (PE <31)

Same as SRG 071 except in PE <31. Capability units represented are IIIs1 and IVs3. Dominant soils are Kyle, Metre, Pierre and Stetter.

SRG 091 (PE 31-44)

Deep and moderately deep, well drained, loamy soils on uplands and bottomland. Slopes range from 0 to 6 percent. Permeability is moderately rapid through the subsoil and rapid or moderately rapid in the underlying material. Available water capacity is low or moderate. These soils have a severe wind erosion hazard. Capability units represented are IIIe7, IIIe8, IIIe9, IIIe10 and IIIe14. Dominant soils are Anselmo, Holt, Munjor and Vetal.

SRG 102 (PE <31)

Same as SRG 091 except in PE <31. Capability units represented are IVe4, IVe5, IVe6 and IVe7. Dominant soils are Assinniboine, Glenberg, Glendive, Rhame and Tuthill.

SRG 111 (PE 31-44)

Deep and moderately deep, well drained clayey soils on uplands. Slopes range from 2 to 6 percent. Permeability is slow or very slow. Available water capacity is low or moderate. The clayey textures retard root growth and penetration and water intake. These soils have moderate wind and water erosion hazards. Only capability unit IIIe4 is represented. Dominant soils are Millboro, Opal and Promise.

SRG 122 (PE <31)

Same as SRG 111 except in PE <31. Only capability unit IVe3 is represented. Dominant soils are Kyle and Pierre.

SRG 131 (PE 31-44)

Deep and moderately deep, well drained clayey soils on uplands. Slopes range from 6 to 9 percent. Permeability is slow or very slow. Available water capacity is low or moderate. The clayey textures retard root growth and penetration and water intake. These soils have a severe water and moderate erosion hazard. Only capability unit IVe4 is in this group. Dominant soils are Boyd, Millboro, Opal and Promise.

SRG 141 (PE 31-44)

Deep and moderately deep, well drained silty and loamy soils on uplands. Slopes range from 9 to 15 percent. Also included are eroded phases of soils where slopes range from 6 to 9 percent. Permeability is moderate. Available water capacity ranges from low to high. These soils have a severe water and moderate wind erosion hazard. Only capability unit IVe1 is represented. Dominant soils are Morton and Oglala.

SRG 152 (PE <31)

Deep and moderately deep, well drained silty and loamy soils and soils with compact clayey subsoils on uplands. Slopes range from 6 to 25 percent. Permeability ranges from moderate to slow. Available water capacity ranges from low to high. These soils have severe water and moderate wind erosion hazards. They generally are not suited for cultivation. Capability units represented are VIe1, VIe3, VIe5 and VIe6. Dominant soils are Belfield, Keith, Oglala, Minnequa and Scroggin.

SRG 161 (PE 31-44)

Deep, excessively drained and somewhat poorly drained sandy soils and well drained loamy soils that are shallow and moderately deep over sand and gravel, mainly on uplands. Slopes range from 0 to 9 percent. Permeability is rapid in the sandy soils, and is moderate through the subsoil and rapid below in the soils underlain with sand and gravel. Available water capacity is very low or low. The sandy soils in this group have a severe wind erosion hazard. Capability units represented are IIIe6, IVe5, IVe9, IVe10 and IVs1. Dominant soils are Akaska, Canning, Doger, Dunday and Elsmere.

SRG 172 (PE <31)

Deep, excessively drained, moderately sandy and sandy soils on uplands with slopes ranging from 0 to 15 percent and well drained loamy soils that are moderately deep over sand and gravel, and slopes ranging from 0 to 6 percent. Permeability is moderately rapid or rapid in the sandy soils and moderate through the subsoils and rapid below in the soils underlain with sand and gravel. Available water capacity is low. The sandy soils have a very severe wind erosion hazard and generally are not suited for cultivation. The soils underlain with sand and gravel have moderate wind and water erosion hazards. Capability units represented are IVe2, IVs1 and VIe10. Dominant soils are Altvan, Lihen, Valentine and Zeona.

SRG 181 (PE 31-44)

Deep and moderately deep, well drained loamy soils on uplands. Slopes range from 6 to 9 percent and from 2 to 6 percent on eroded phases. Permeability is moderately rapid through the subsoil and moderately rapid or rapid in the underlying material. Available water capacity is low or moderate. These soils have a severe wind and moderate water erosion hazard. Only capability unit IVe8 is represented. Dominant soils are Anselmo, Holt, Lefor, Tuthill and Vebar.

SRG 191 (PE 31-44)

Deep and moderately deep, moderately well drained soils with claypan subsoils on uplands. Slopes range from 0 to 6 percent. Permeability is slow or very slow. Available water capacity is low or moderate. These soils have unfavorable rooting zones. The soils with sandy loam surface layers have a severe wind erosion hazard. Capability units represented are IVs2, IVs3 and IVe13. Dominant soils are Mosher, Sorum and Wortman.

SRG 192 (PE <31)

Same as SRG 191 except in PE <31. Capability units represented are IVe12 and IVs2. Dominant soils are Ekalaka and Sorum.

SRG 203 (PE <31 and PE 31-44)

This group includes deep, moderately well to very poorly drained, sandy to clayey soils on bottomland, upland depressions and basins. They are subject to flooding from stream overflow, channeled, ponded or have a seasonal water table. Permeability ranges from rapid to very slow. Available water capacity ranges from low to high. The soils suitable for cultivation in this group require careful selection of crops and planting dates are often delayed because of wetness. Capability units represented are IIw1, IIw2, IIw5, IIIw2, IIIw3, IIIw4, IIIw5, IIIw6, IIIw8, IVw3, IVw4, Vw1, Vw3, Vw4, Vw7, VIw1, VIw2, VIw3 and VIw4. Dominant soils in this group are Dimmick, Harriet, Lamo and Loup and the land types, loamy, alluvial land, clayey alluvial and channeled phases of those land types.

SRG 211 (PE 31-44)

Deep and moderately deep, well drained loamy to clayey soils on uplands. Slopes range from 9 to 25 percent. Permeability ranges from moderate to very slow. Available water capacity ranges from low to high. The severe erosion hazard makes these soils generally unsuited for cultivation. Capability units represented are VIe1, VIe3 and VIe4. Dominant soils are Boyd, Keota, Oglala and Opal.

<u>SRG 231</u> (PE 31-44)

Shallow, well drained to excessively drained loamy to clayey soils on uplands. Slopes range from 0 to 25 percent. Permeability ranges from moderately rapid to slow. Available water capacity is very low or low. The soils have limited rooting depth and a severe erosion hazard on the steeper slopes. They are not generally suited for cultivation. Capability units represented are VIe10, VIs2 and VIs3. Dominant soils are Cabba and Sansarc.

<u>SRG 232</u> (PE <31)

Same as SRG 231 except in PE <31. Capability units represented are VIs1 and VIs2. Dominant soils are Cabbart, Epping, Grummit, Lismas and Samsil.

<u>SRG 241</u> (PE 31-44)

Deep to shallow, well to poorly drained soils with loamy to clayey surface layers in depressions, on uplands and terraces. Slopes are mainly less than 6 percent but range up to 25 percent. Permeability is slow or very slow. Available water capacity ranges from very low to moderate. These soils have dense claypan subsoils, salts near the surface, are frequently ponded or a combination of these limitations. These soils are not generally suited for cultivation. Capability units represented are VIs1, VIIe5 and VIIs7. Dominant soils are Hurley and Rhoades.

<u>SRG 242</u> (PE <31)

Same as SRG 241 except in PE <31. Capability units represented are VIs3 and VIIe4. Dominant soils are Absher and Hisle.

<u>SRG 251</u> (PE 31-44)

Deep to shallow, well or moderately well drained clayey soils on uplands. Slopes are mainly less than 6 percent, but range up to 25 percent. Permeability is slow or very slow. Available water capacity ranges from very low to moderate. Plant growth is restricted by the strong alkalinity, high salt concentrations or claypan subsoil. They are not generally suited for cultivation. Capability units represented are VIe9, VIs5 and VIIs7. Dominant soils are Archin, Chantier and Swanboy.

SRG 252 (PE <31)

Same as SRG 251 except in PE <31. Capability units represented are VIs5, VIs6, VIIs8 and VIIs9. Dominant soils are Archin, Swanboy, Wasa, Winler and Wortman.

SRG 261 (PE 31-44)

Deep to shallow, well to excessively drained, silty to clayey soils on uplands. Slopes range from 25 to 40 percent or more. The shallow soils have limited rooting depth. These soils have a very severe water erosion hazard and are not suited for cultivation. Capability units represented are VIe2, VIIe2, VIIe3, VIIs1 and VIIs2. Dominant soils are Cabba, Canyon, Opal and Sansarc.

SRG 262 (PE <31)

Deep to shallow, well to excessively drained, silty to clayey soils on uplands. Slopes range from 25 to 40 percent or more except for the very saline soils in this group. The shallow and saline soils have limited rooting depth. These soils have a very severe water erosion hazard and are not suited for cultivation. Capability units represented are VIIe1, VIIe2, VIIs1, VIIs2 and VIIs3. Dominant soils are Cabbart, Epping, Lismas and Samsil.

SRG 273 (PE 31-44 and PE <31)

Included in this group is rough mountainous land, rough broken land or very stony land containing very shallow to deep soils. Slopes range from 2 to 50 percent or more. Only capability unit VIIs6 is represented. It includes the land types rough mountainous land and rough unbroken land.

SRG 281 (PE 31-44)

Well drained to excessively drained loamy soils that are moderately deep to shallow over sand and gravel. Slopes range from 6 to 50 percent. Available water capacity is very low or low. These droughty soils have limited rooting depth. They are not suited for cultivation. Capability units represented are VIe5, VIs4 and VIIs4. Dominant soils are Murdo and Schamber.

SRG 282 (PE <31)

Same as SRG 281 except in PE <31. Capability units represented are VIe2, VIs4 and VIIs4. Dominant soils are Beaverton, Murdo and Schamber.

SRG 293 (PE 31-44 and PE <31)

Included in this group are barren or nearly barren sand blowouts, riverwash, rock outcrop, rock land, badland, gravel pits and marshes. These areas have little or no value as agricultural lands but may be suited for wildlife or recreation.

Acreage data for current land use and treatment needs were first developed on the individual county base. Counties were later grouped to form five analytical units. The 37 SRG's do not necessarily exist in all counties or more than one county group. Pasture may occur on all 37 SRG's but only 35 of them can appear as cropland. Range and grazed noncommercial forestlands were further condensed into 10 SRG's as listed in Table C-1. The object of including this category of forestland is that the involved area is large and definitionally in forest use. Production and soil loss are accounted for but land use conversion is not allowed in the operation of the model.

Current Cropping Pattern

Planned uses of the linear program required that the current pattern of major land uses and the acreage of major crops be superimposed on the SRG's within counties. This was done through the use of computer programmed normalizing procedures. Published 1967 CNI data provided the framework within which the current cropping pattern was "created". Land uses and crops that appear in this pattern are listed in Table C-2. In most cases, the acreage data base for these crops was computed as the average of the 1968-1972 Crop and Livestock Reporting Service statistical data series. For the remainder of the crops the 1969 Agricultural Census served as the primary acreage data source.

Current Yields

Crop categories listed under cropland use in Table C-2 were condensed under fewer headings by casting relatively minor categories in with major categories. This was done on the basis of similarities in the generation of soil loss and revenue. These major crop categories then participate in the specified series of alternative rotations discussed in a later section. Individual crops appearing among these alternative rotations are indicated by an asterisk and footnoted in Table C-2.

Table C-3 lists the crops normally grown on irrigated and nonirrigated land. Pasture and rangeland uses continue as such in the model. Grazed noncommercial forestland is included in the LP but was not subject to conversion to other major uses. These acres competed within the maximum profit objective on the basis of

Table C-1 -- DERIVATION OF RANGE-FOREST SRG'S[1/]

Range-Forest SRG No.	Derivative Cropland-Pasture SRG Nos.
311	011
312	022
321	031,051,071,091,111,131,141,161,181, 191,221
332	042,062,082,102,122,152,172,192,212, 222
343	203
351	211,231,251,261
362	232,252,262
371	241,281
382	242,273,282
393	293

1/ Grazed, noncommercial forestlands only.

Table C-2 -- CROP CATEGORIES IN THE CURRENT CROPPING PATTERN

Land Use	Crop Categories	
Cropland	*CØRN GRAIN	*SUMMER FALLØW
	*CØRN SILAGE	*ALFALFA HAY
	*SØRGHUM GRAIN	CRØPLAND PASTURE
	*SØRGHUM SILAGE	*IRR ALFALFA HAY
	*IRR CØRN GRAIN	IRR CRØPLAND PASTURE
	*IRR CØRN SILAGE	ØTHER HAY 3/
	ØTHER RØW CRØPS 1/	IRR ØTHER HAY 3/
	IRR ØTHER RØW 1/	CØNSERVATIØN USE 4/
	*WINTER WHEAT	IRR CØNSERVATIØN USE 4/
	*ALL SPRING WHEAT	UNHARVESTED CRØPLAND
	*ØATS	ØRCHARDS
	ØTHER SMALL GRAIN 2/	IRR ØRCHARDS
	*IRR ØATS	ØPEN LAND
Pasture	PASTURE	
Range	RANGE	
Forest	FØREST CØM NØT GRAZED	
	FØREST CØM GRAZED	
	FØREST NØN CØM NØT GRAZED	
	FØREST NØN CØM GRAZED	
Other	ØTHER LAND IN FARMS	
	ØTHER LAND NØT IN FARMS	

1/ Corn fodder, sorghum hay, sorghum grazed.
2/ Barley, flax, rye.
3/ Tame hay (other than alfalfa) and wild hay.
4/ Per CNI definition, p. 13 of National Handbook.

* Individual crops that appear in alternative future rotations.

Table C-3 -- CONSTITUENT CROPS IN MAJOR CROP CATEGORIES

Irrigated

Major Category	Participating Categories
Corn/grain	Sorghum/grain
Corn/silage	Sorghum/silage
	Sorghum/forage or hay
	Sorghum-hogged or grazed
Alfalfa hay	None
Oats	Winter wheat/grain
	Durum wheat/grain
	Small grain hay
	Barley/grain

Nonirrigated

Major Category	Participating Categories
Corn/grain	None
Corn/silage	Corn/fodder
Sorghum/grain	None
Sorghum/silage	Sorghum/forage or hay
	Sorghum/hogged or grazed
Wheat wheat	
Summer fallow	None
Cont. cropped	None
Spring wheat (other)	
Summer fallow	Durum/summer fallow
Cont. cropped	Durum/cont. cropped
Oats	None
Barley	Flax
	Rye
Hay	
Alfalfa	None
Permanent (other than alfalfa)	Tame hay (other than alfalfa)
	Wild hay

alternative range management systems. In this way, production and soil loss from this land use category were accounted for.

Initial estimates of current yields of major crops were based on the 1973 Soil Conservation Service publication, Predicted Yields for the Soils of South Dakota. This publication lists expected yields of selected crops, pasture and range under average and high levels of management on specific soil series within Major Land Resource Areas. CNI acreages of soil series comprising SRG's were teamed with the predicted yield data to produce weighted mean yield estimates by SRG. These yields were then adjusted to reflect per acre yields developed as an average of the 5-year statistical data series. By means of this procedure the estimated relative differences in production performance under average and high levels of management were maintained. The procedure was implemented on the basis of counties grouped to form Yield Subareas (see Figure C-2).

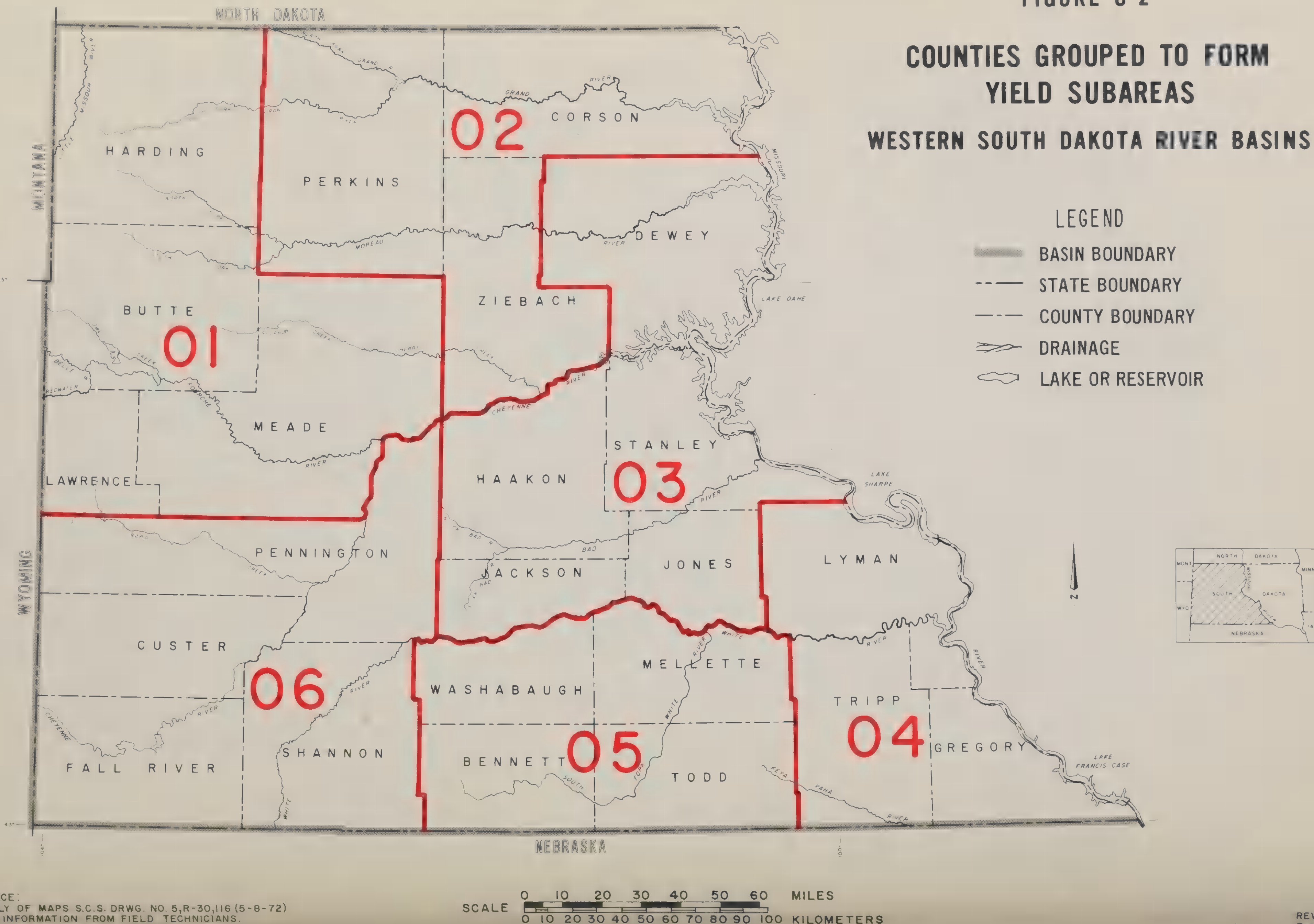
The data were input to the matrix of management alternatives provided for within the LP. Yields under average management were inserted in that combination of management practices that are normally used in the area. High management yields were associated with the combination of management factors known to be superior under specific SRG conditions. The two points in the spectrum of alternative rotations, tillage systems, land treatment and management systems served as benchmarks for the expansion of current yield estimates across the array of management alternatives.

Estimates of current yields of cultivated crops are listed in Appendix E, Crop Yield and Cost Data. For analytical purposes, the cultivated crop yield subareas depicted in Figure C-2 are merged into the county groups for LP analyses, shown in Figure 1 of Chapter 4. Counties were further differently grouped for purposes of estimating pasture yields. The three production areas shown in Figure C-3 reflect the significant yield-affecting factors of amount, effectiveness and seasonal distribution of precipitation. The line separating the western production area from the eastern production area represents a demarcation in yield-influencing precipitation effectiveness or P.E. line. Current yield estimates derived through the previously described procedures were applied to three pasture management systems and all SRG's that occur within production areas. Weighted mean yields under average management are synonymous with continuous season-long moderate use. Yields under high level of management are equated with pasture being managed as improved grazing systems. Continuous heavy use of pastures produces estimated yields at the rate of 50 percent of those obtained under a high level of management. The yield production factor is in terms of Animal Unit Months (AUM's) of grazing per acre. Table C-4 shows the SRG production factors developed for the three management systems and the three production areas. These yield estimates apply to the current and all future time frames.

FIGURE C-2

COUNTIES GROUPED TO FORM YIELD SUBAREAS

WESTERN SOUTH DAKOTA RIVER BASINS



SOURCE:
FAMILY OF MAPS S.C.S. DRWG. NO. 5,R-30,116 (5-8-72)
AND INFORMATION FROM FIELD TECHNICIANS.
LAMBERT CONFORMAL CONIC PROJECTION

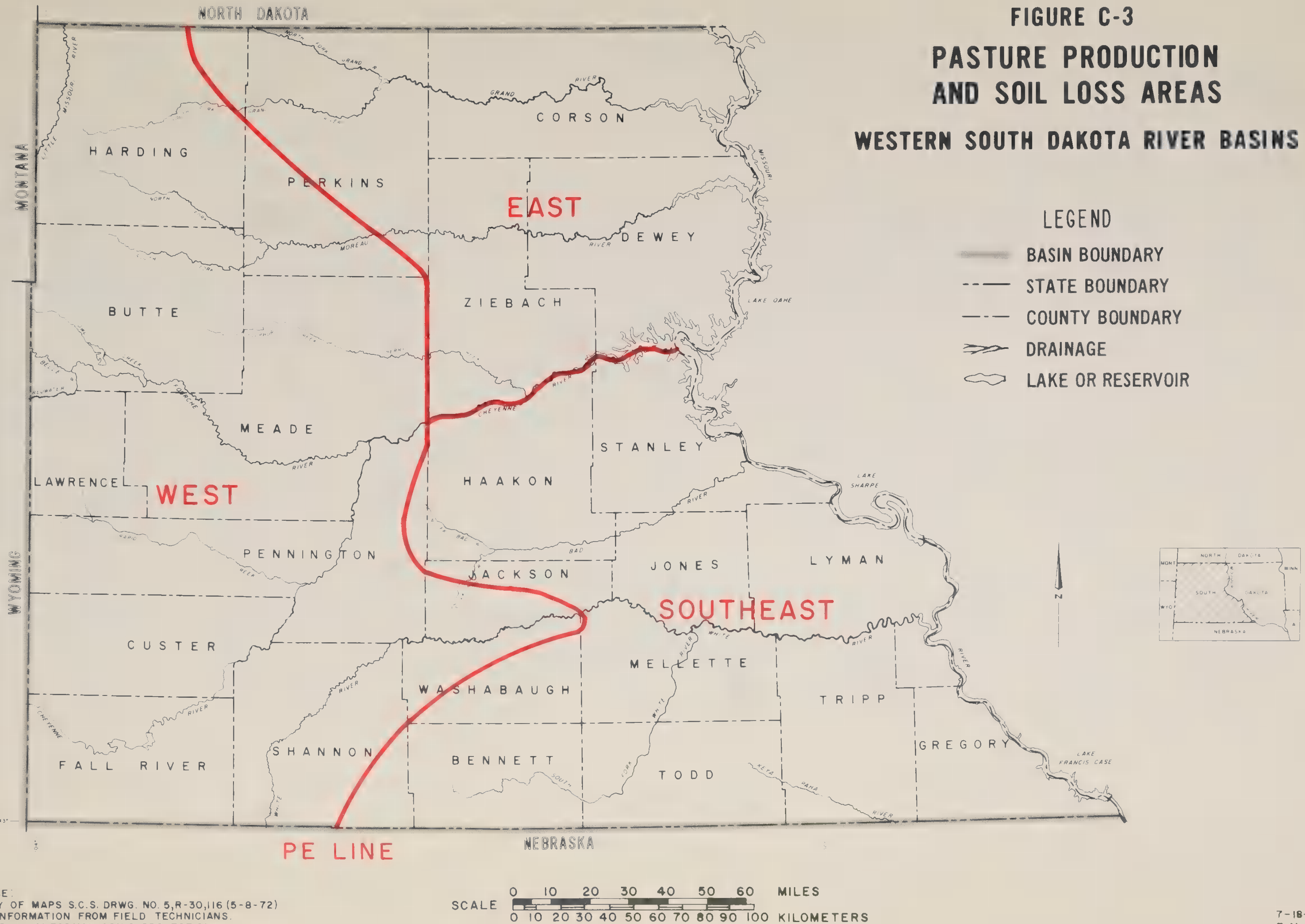
REV. 7-18-79
5,N-36,987

USDA-SCS LINCOLN NEBR 1979

FIGURE C-3

PASTURE PRODUCTION AND SOIL LOSS AREAS

WESTERN SOUTH DAKOTA RIVER BASINS



SOURCE:
FAMILY OF MAPS S.C.S. DRWG. NO. 5,R-30,116 (5-8-72)
AND INFORMATION FROM FIELD TECHNICIANS.
LAMBERT CONFORMAL CONIC PROJECTION

7-18-79
5,N-37,477

USDA-SCS-LINCOLN, NEBR. 1979

Table C-4 -- PRODUCTION FACTORS FOR PASTURE

SRG	Production Areas								
	East			West			Southeast		
	Management Systems								
	Continuous Heavy Use	Continuous Moderate Use	Improved Grazing Systems	Continuous Heavy Use	Continuous Moderate Use	Improved Grazing Systems	Continuous Heavy Use	Continuous Moderate Use	Improved Grazing Systems
	AUM's								
011	1.6	2.1	3.0				1.9	2.5	3.6
022				1.3	1.7	2.5			
031	1.4	1.8	2.6				1.6	2.1	3.0
042				1.1	1.5	2.2			
051	1.1	1.5	2.2				1.3	1.7	2.4
062				1.1	1.4	2.0			
071	1.4	1.8	2.5				1.6	2.1	3.0
082				1.1	1.4	2.0			
091	1.4	1.8	2.5				1.5	2.0	2.8
102				1.1	1.5	2.2			
111	1.2	1.6	2.3				1.4	1.9	2.7
122				0.9	1.2	1.8			
131	1.1	1.5	2.2				1.3	1.7	2.4
141	1.0	1.3	1.8				1.1	1.4	2.0
152				0.8	1.0	1.4			
161	1.0	1.3	1.9				1.5	2.0	2.8
172				0.6	0.8	1.1			
181	1.0	1.3	1.9				1.1	1.5	2.2
191	0.9	1.2	1.7				1.1	1.4	2.0

(Continued)

Table C-4 -- PRODUCTION FACTORS FOR PASTURE (Continued)

SRG	East: Continuous Heavy Use	East: Continuous Moderate Use	East: Improved Grazing Systems	West: Continuous Heavy Use	West: Continuous Moderate Use	West: Improved Grazing Systems	Southeast: Continuous Heavy Use	Southeast: Continuous Moderate Use	Southeast: Improved Grazing Systems
	AUM's								
192				0.6	0.8	1.1			
203	2.1	2.8	4.0	1.5	2.0	2.8	2.4	3.2	4.5
211	0.8	1.0	1.4				1.0	1.3	1.8
212				0.6	0.8	1.1			
221	0.6	0.8	1.1				0.8	1.0	1.4
222				0.5	0.6	0.8			
231	0.5	0.6	0.8				0.5	0.7	1.0
232				0.4	0.5	0.7			
241	0.5	0.6	0.8				0.6	0.8	1.1
242				0.3	0.4	0.6			
251	0.5	0.7	1.0				0.7	0.9	1.3
252				0.4	0.5	0.7			
261	0.5	0.6	0.8				0.6	0.8	1.1
262				0.3	0.4	0.6			
273	0.4	0.5	0.7	0.3	0.4	0.6	0.5	0.6	0.8
281	0.3	0.35	0.5				0.3	0.4	0.6
282				0.2	0.3	0.4			
293	0	0	0	0	0	0	0	0	0

Current production factors for range were developed and projected by means of the previously described methodology applied to cultivated crops. Estimated yields under six alternative management systems, ten range SRG's and three antecedent land treatment conditions are shown in Table C-5. Production from grazed forestland relates to the same 10 SRG's and the three antecedent land treatment need conditions of adequate, inadequate and reseeding needed. Production factors were limited to the maintenance of existing conditions and remain constant over time.

Cropland Management Alternatives

A series of 12 nonirrigated crop rotations plus permanent hay and three irrigated rotations were identified as being practicable and appropriate under the conditions afforded by the area. The nonirrigated rotations are made up of nine major crops plus summer fallow and permanent hay. The three irrigated rotations include four major crops. Crop sequences comprising these rotations are listed in Table C-6.

Two alternative methods of tillage were incorporated in the model. One is the conventional tillage system which is typified by spring or fall plowing, two diskings, harrowing and planting, plus other operations typical of conventional practice in the area. Minimum tillage is the second alternative. This system is definitionally broad because of the need to gather the several types of reduced tillage systems under a single heading. Use of the term is imprecise because of this but it is best summed as minimizing the amount of tillage used to prepare the soil, establish plants and prevent competitive growth.

Five classes of conservation treatment made up the array of alternatives. These included no treatment; contour farming; use of windstripping/windbreaks; contour strip cropping; and terracing.

Referring to Figure C-1 it can be seen that this description of the LP is at the point that current and projected yields of involved crops from all land uses have been traced through developmental methodology to sources of reference for all input data. The majority of this data appears in Appendix E and the remainder is presented within this appendix.

Soil Loss

Estimated soil losses by wind and water erosion occurring with every possible combination of rotations, tillage systems and land treatment practices under cropland conditions are contained in Appendix F, Soil Loss Data. These input data are presented in a separate appendix due to the volume of tables involved.

Table C-5 -- PRODUCTION FACTORS FOR RANGE AND GRAZED FORESTLAND

SRG	Conditions	Main Exist. Con.		Continuous Heavy Use				Continuous Proper Use				Planned Grazing Systems				Mechanical Treatment				Reseeding			
		1975	Futures	1975	1985	2000	2020	1975	1985	2000	2020	1975	1985	2000	2020	1975	1985	2000	2020	1975	1985	2000	2020
		AUM's																					
311	Adeq.	.50	Same	.80	.62	.35	.27	.50	.72	.72	.72	.50	.94	.94	.94	.50	.83	.83	.83	.50	.83	.83	.83
	Inadeq.	.32	Same	.51	.34	.27	.27	.32	.50	.72	.72	.32	.8	.94	.94	.32	.66	.83	.83	.32	.83	.83	.83
	Reseed	.11	Same	.18	.18	.18	.18	.11	.25	.46	.72	.11	.39	.81	.94	.11	.32	.64	.83	.11	.83	.83	.83
312	Adeq.	.42	Same	.67	.42	.29	.24	.42	.58	.6	.6	.42	.78	.78	.78	.42	.69	.69	.69	.42	.69	.69	.69
	Inadeq.	.27	Same	.42	.28	.24	.24	.27	.41	.6	.6	.27	.63	.78	.78	.27	.54	.69	.69	.27	.69	.69	.69
	Reseed	.09	Same	.14	.14	.14	.14	.09	.20	.37	.59	.09	.31	.64	.78	.09	.26	.52	.69	.09	.69	.69	.69
321	Adeq.	.42	Same	.67	.50	.24	.24	.42	.6	.6	.6	.42	.78	.78	.78	.42	.69	.69	.69	.42	.69	.69	.69
	Inadeq.	.27	Same	.42	.28	.24	.24	.27	.42	.6	.6	.27	.61	.78	.78	.27	.55	.69	.69	.27	.69	.69	.69
	Reseed	.09	Same	.14	.14	.14	.14	.09	.19	.34	.54	.09	.29	.59	.78	.09	.22	.41	.69	.09	.69	.69	.69
332	Adeq.	.35	Same	.56	.40	.19	.19	.35	.5	.5	.5	.35	.65	.65	.65	.35	.58	.58	.58	.35	.58	.58	.58
	Inadeq.	.23	Same	.37	.21	.19	.19	.23	.33	.48	.5	.23	.49	.65	.65	.23	.45	.58	.58	.23	.58	.58	.58
	Reseed	.08	Same	.13	.13	.13	.13	.08	.16	.28	.44	.08	.24	.48	.65	.08	.19	.36	.58	.08	.58	.58	.58
343	Adeq.	.84	Same	1.34	1.09	.72	.48	.84	1.2	1.2	1.2	.84	1.6	1.6	1.6	.84	1.38	1.38	1.38	.84	1.38	1.38	1.38
	Inadeq.	.54	Same	.86	.61	.48	.48	.54	.87	1.2	1.2	.54	1.42	1.6	1.6	.54	1.14	1.38	1.38	.54	1.38	1.38	1.38
	Reseed	.18	Same	.29	.29	.29	.29	.18	.35	.61	.95	.18	.65	1.36	1.6	.18	.48	.93	1.38	.18	1.38	1.38	1.38
351	Adeq.	.35	Same	.56	.38	.19	.19	.35	.5	.5	.5	.35	.65	.65	.65	.35	.58	.58	.58	.35	.58	.58	.58
	Inadeq.	.23	Same	.37	.19	.19	.19	.23	.35	.5	.5	.23	.55	.65	.65	.23	.46	.58	.58	.23	.58	.58	.58
	Reseed	.08	Same	.13	.13	.13	.13	.08	.17	.31	.5	.08	.26	.53	.65	.08	.21	.41	.58	.08	.58	.58	.58
362	Adeq.	.28	Same	.45	.29	.16	.16	.28	.4	.4	.4	.28	.52	.52	.52	.28	.46	.46	.46	.28	.46	.46	.46
	Inadeq.	.18	Same	.29	.16	.16	.16	.18	.27	.4	.4	.18	.42	.52	.52	.18	.36	.46	.46	.18	.46	.46	.46
	Reseed	.06	Same	.10	.10	.10	.10	.06	.13	.24	.38	.06	.2	.41	.52	.06	.16	.31	.46	.06	.46	.46	.46
371	Adeq.	.25	Same	.4	.23	.14	.14	.25	.35	.35	.35	.25	.46	.46	.46	.25	.40	.40	.40	.25	.40	.40	.40
	Inadeq.	.16	Same	.26	.14	.14	.14	.16	.24	.35	.35	.16	.36	.46	.46	.16	.28	.40	.40	.16	.40	.40	.40
	Reseed	.05	Same	.08	.08	.08	.08	.05	.11	.2	.32	.05	.17	.35	.46	.05	.13	.25	.40	.05	.40	.40	.40
382	Adeq.	.14	Same	.22	.11	.08	.08	.14	.2	.2	.2	.14	.26	.26	.26	.14	.23	.23	.23	.14	.23	.23	.23
	Inadeq.	.09	Same	.14	.08	.08	.08	.09	.13	.19	.2	.09	.2	.26	.26	.09	.16	.23	.23	.09	.23	.23	.23
	Reseed	.03	Same	.05	.05	.05	.05	.03	.06	.11	.17	.03	.09	.18	.26	.03	.07	.13	.21	.03	.23	.23	.23
393	Adeq.																						
	Inadeq.	NO PRODUCTION																					
	Reseed																						

Table C-6 -- ALTERNATIVE ROTATIONS

Nonirrigated	Irrigated
C-O	C-D
D-O	O_x-A-A-A-A
C-O-D-O_x-A-A-A-A	C-C-C-O_x-A-A-A-A
C-S-D-O_x-A-A-A-A	
W-M-O-F	
W-N-O-F	
W-M-F	
S-F	
W-F	
C-O_x-A-A-A-A	
D-O_x-A-A-A-A	
S-O_x-A-A-A-A	
P	

Where:

C = Corn/grain
D = Corn/silage
M = Sorghum/grain
N = Sorghum/silage
W = Winter wheat
S = Spring wheat
O = Oats
O_x = Oats seeded down
F = Summer fallow
A = Rotation alfalfa
P = Permanent hay

Soil loss estimates for pasture apply to the current and all future time frames. These data are presented in Table C-7 on the basis of three production areas and three management systems within each production area, by SRG as they exist within production areas. Soil losses under pasture conditions are at modest levels. The only exception to this occurs on SRG 293 which includes the "badlands" of South Dakota. There is great variation in the erodibility of these soils, even though they occur in the same SRG. The 38 tons soil loss per acre per year is an average of the conditions within the SRG and, therefore, masks the extremes.

Soil loss factors for range and grazed forestlands are required for each set of production factors contained in Table C-5. These estimates are listed in Table C-8 in relation to the six management systems, three antecedent land treatment conditions and ten range SRG's. In the case of range and grazed forestlands the entire study area is treated as a single production area. In the case of SRG 393, soil loss is shown only under the circumstance of maintaining existing conditions as the other five management systems are not applicable to the cross section of these land conditions.

Price Assumptions

Within this study setting, agricultural price standards applied to major commodities are specified by the U.S. Water Resources Council. Price assumptions as input to the LP are listed in Table C-9. The listing is a mix of price standards as specified by the Council for identified commodities and other price standards independently developed in the absence of current normalized prices. The silages, hays and grazing elements of production were valued in the basis of nutritional value and local market values prevailing during 1974.

Production Costs

Current and projected total cost of production of individual field crops as they occur within management strategies by SRG and county group are presented in Appendix E, Crop Yield and Cost Data. Similarly, the total cost of production of all rotational sequences within available management strategies by SRG and county group are shown in Appendix G, Income, Cost and Net Revenue. This appendix is also separately available. A management strategy is an aggregation of management systems, i.e. simultaneous specification of rotation, tillage system and type of land treatment.

Crop budgets were developed for the 10 nonirrigated crops and four irrigated crops which appear in the 13 nonirrigated and three irrigated alternative rotations. Whenever possible, the basic budgets were adaptions of Firm Enterprise Data System (FEDS) located

Table C-7 -- SOIL LOSS FACTORS FOR PASTURE

SRG	Production Areas								
	East			West			Southeast		
	Management Systems								
	Continuous Heavy Use	Continuous Moderate Use	Improved Grazing Systems	Continuous Heavy Use	Continuous Moderate Use	Improved Grazing Systems	Continuous Heavy Use	Continuous Moderate Use	Improved Grazing Systems
	Tons/Acre/Year								
011	.06	.04	.03				.07	.04	.03
022				.05	.04	.03			
031	.18	.13	.09				.22	.14	.10
042				.16	.12	.09			
051	.39	.28	.21				.46	.32	.26
062				.35	.25	.19			
071	.05	.04	.03				.06	.04	.03
082				.05	.04	.03			
091	.10	.07	.05				.11	.08	.06
102				.09	.06	.05			
111	.20	.14	.11				.22	.15	.12
122				.19	.14	.11			
131	.43	.30	.23				.50	.35	.28
141	.55	.43	.34				.69	.50	.38
152				.51	.38	.33			
161	.11	.08	.06				.11	.08	.06
172				.11	.09	.08			
181	.17	.13	.10				.20	.14	.11
191	.16	.12	.09				.19	.14	.11

(Continued)

Table C-7 -- SOIL LOSS FACTORS FOR PASTURE (Continued)

SRG	East: Continuous Heavy Use	East: Continuous Moderate Use	East: Improved Grazing Systems	West: Continuous Heavy Use	West: Continuous Moderate Use	West: Improved Grazing Systems	Southeast: Continuous Heavy Use	Southeast: Continuous Moderate Use	Southeast: Improved Grazing Systems
	Tons/Acre/Year								
192				.15	.12	.11			
203	.04	.03	.02	.04	.03	.02	.05	.03	.02
211	.67	.50	.44				.76	.59	.46
212				.59	.48	.42			
221	.30	.24	.22				.36	.27	.23
222				.26	.23	.20			
231	.59	.51	.46				.71	.60	.50
232				.49	.45	.40			
241	.22	.19	.17				.26	.21	.19
242				.19	.18	.16			
251	.25	.21	.18				.29	.24	.21
252				.22	.20	.18			
261	.92	.80	.71				1.10	.89	.79
262				.81	.74	.67			
273	1.69	1.54	1.38	1.47	1.34	1.22	2.11	1.82	1.63
281	.33	.32	.29				.41	.38	.34
282				.28	.26	.25			
293	38.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0

Table C-8 -- SOIL LOSS FACTORS FOR RANGE AND GRAZED FORESTLAND

SRG	Conditions	Main Exist. Con.: 1975	Main Exist. Con.: Futures	Continuous Heavy Use: 1975	Continuous Heavy Use: 1985	Continuous Heavy Use: 2000	Continuous Heavy Use: 2020	Continuous Proper Use: 1975	Continuous Proper Use: 1985	Continuous Proper Use: 2000	Continuous Proper Use: 2020	Planned Grazing Systems: 1975	Planned Grazing Systems: 1985	Planned Grazing Systems: 2000	Planned Grazing Systems: 2020	Mechanical Treatment: 1975	Mechanical Treatment: 1985	Mechanical Treatment: 2000	Mechanical Treatment: 2020	Reseeding: 1975	Reseeding: 1985	Reseeding: 2000	Reseeding: 2020
		AUM's																					
311	Adeq.	.00	Same	.00	.00	.30	.50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	Inadeq.	.00	Same	.00	.30	.40	.50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	Reseed	.50	Same	.50	.50	.50	.50	.50	.20	.00	.00	.40	.00	.00	.00	.50	.00	.00	.00	.50	.00	.00	.00
312	Adeq.	.00	Same	.00	.00	.1	.2	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	Inadeq.	.00	Same	.00	.1	.2	.2	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	Reseed	.20	Same	.20	.2	.2	.2	.20	.10	.00	.00	.20	.00	.00	.00	.20	.00	.00	.00	.20	.00	.00	.00
321	Adeq.	.20	Same	.20	.20	1.00	1.80	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20
	Inadeq.	.30	Same	.30	1.30	1.80	1.80	.30	.20	.20	.20	.30	.20	.20	.20	.30	.20	.20	.20	.30	.20	.20	.20
	Reseed	1.80	Same	1.80	1.80	1.80	1.80	1.80	1.00	.30	.20	1.80	.30	.20	.20	1.80	.30	.20	.20	1.80	.20	.20	.20
332	Adeq.	.20	Same	.20	.30	1.3	1.60	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20
	Inadeq.	.50	Same	.50	1.10	1.60	1.60	.50	.20	.20	.20	.50	.20	.20	.20	.40	.20	.20	.20	.40	.20	.20	.20
	Reseed	1.60	Same	1.60	1.60	1.60	1.60	1.60	.80	.30	.20	1.60	.50	.20	.20	1.60	.50	.20	.20	1.60	.20	.20	.20
343	Adeq.	.00	Same	.00	.00	.10	.30	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	Inadeq.	.00	Same	.00	.20	.30	.30	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	Reseed	.30	Same	.30	.30	.30	.30	.30	.20	.00	.00	.30	.00	.00	.00	.30	.00	.00	.00	.30	.00	.00	.00
351	Adeq.	.7	Same	.7	1.30	3.20	3.50	.7	.7	.7	.7	.7	.7	.7	.7	.7	.7	.7	.7	.7	.7	.7	.7
	Inadeq.	1.30	Same	1.30	3.20	3.50	3.50	1.30	.7	.7	.7	1.30	.7	.7	.7	1.30	.7	.7	.7	1.30	.7	.7	.7
	Reseed	3.50	Same	3.50	3.50	3.50	3.50	3.50	2.80	2.10	.70	3.50	1.30	.7	.7	3.50	1.30	.7	.7	3.50	.7	.7	.7
362	Adeq.	.70	Same	.70	1.50	2.40	3.50	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70
	Inadeq.	1.50	Same	1.50	2.40	3.50	3.50	1.50	.70	.70	.70	1.50	.70	.70	.70	1.50	.70	.70	.70	1.50	.70	.70	.70
	Reseed	3.50	Same	3.50	2.50	3.50	3.50	3.50	1.90	.80	.70	3.50	1.30	.70	.70	3.50	1.30	.70	.70	3.50	.70	.70	.70
371	Adeq.	.30	Same	.30	.70	.90	1.10	.30	.30	.30	.30	.30	.30	.30	.30	.30	.30	.30	.30	.30	.30	.30	.30
	Inadeq.	.60	Same	.60	.90	1.00	1.10	.60	.30	.30	.30	.60	.30	.30	.30	.60	.30	.30	.30	.60	.30	.30	.30
	Reseed	1.10	Same	1.10	1.10	1.10	1.10	1.10	.80	.40	.30	1.10	.60	.30	.30	1.10	.60	.30	.30	1.10	.30	.30	.30
382	Adeq.	.5	Same	.5	.70	1.30	1.70	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
	Inadeq.	.60	Same	.10	1.30	1.60	1.70	.60	.5	.5	.5	.60	.5	.5	.5	.60	.5	.5	.5	.60	.5	.5	.5
	Reseed	1.70	Same	1.70	1.70	1.70	1.70	1.70	1.10	.60	.5	1.70	.60	.5	.5	1.70	.60	.5	.5	1.70	.5	.5	.5
393	Adeq.		Same	NO PRODUCTION																			
	Inadeq.		Same																				
	Reseed		Same																				

Table C-9 -- AGRICULTURAL PRICE STANDARDS

Crop	Unit	Price
Corn/grain	Bushel	$ 2.48 1/
Corn/silage	Ton	16.00 2/
Sorghum/grain	Bushel	2.25 1/
Sorghum/silage	Ton	15.95 2/
Wheat	Bushel	3.80 1/
Oats	Bushel	1.37 1/
Alfalfa hay	Ton	48.51 2/
Other hay	Ton	35.46 2/
Grazing 2/	AUM	9.00 2/

1/ Price standards as determined by the U.S. Water Resources Council.
2/ Price determined on the basis of comparable nutritional value and local market value.

at Oklahoma State University. These budgets derive from cost data originating at the farm operator level. Budgets developed for 1974 for FEDS Production Areas within the study area were adapted when available. In some situations older budgets from within or near the Production Area were updated and adapted. In still other cases 1974 budgets from adjacent areas were adapted. These budgets include variable costs and ownership costs but do not include a land or management charge.

Harvest costs are a subset within variable costs and include costs for custom services in harvesting crops. To the extent that custom harvest costs were incurred in any given FEDS budget, they were computed on a cost per unit of production basis. This element of variable cost then moved with estimated yields by SRG and management strategy. Harvest costs appear as a separate item in Appendix E. Costs of fertilizer and pesticides were set at 1974 levels for the current situation. These costs per unit remained constant over time but the level of application was projected to increase at rates reflecting the level of adaptation of SRG's to the application of technology. SRGs within the high adaptability group were projected to reach present high management yield levels by 2020. Medium and low adaptability groups were each projected at 10 percent lesser rates than the highly adapted group. Fertilizer and perticide costs as they are projected to change over time are incorporated in the total cost column of Appendix E.

Estimated costs for pasture management systems remain constant among SRG's and over time. When managed as continuous heavy use, average annual costs for maintenance of fences and water facilities and eight year cycles for renovation or reestablishment is $4.80. Continuous season-long moderate use results in average annual costs reflecting the same categories of costs but with renovation gauged to a ten year cycle and therefore lesser costs of $4.35. Managed as improved grazing systems, the ten year renovation cycle continues but the cost of additional fence and water facilities plus fertilizer and clipping raises the average annual costs to $11.35. Other considerations such as loss of production during the year following reseeding are taken into account. Greater labor costs associated with improved grazing systems are recognized.

Production costs for management practices and systems on rangeland and grazed forestland were computed as described below. Maintenance of Existing Conditions and Continuous Heavy Use management systems carry annual costs of 75¢ per acre for the maintenance of fences and water facilities. Costs under the four remaining management systems were estimated on the basis of antecedent or treatment needs conditions. These costs are entailed by maintenance of fences and water facilities plus costs of establishment where appropriate within management systems. Production costs of these management systems as applied under three antecedent treatment needs conditions are listed in Table C-10.

Table C-10 -- PRODUCTION COSTS FOR RANGE AND GRAZED FORESTLANDS

Management Systems	Treatment Needs Condition	Total Average Annual Cost Per Acre	Cost Elements: Maintenance1/	Cost Elements: Establishment	Notations
Continuous Proper Use	Adequate	$ .75	$ .75	NA	
	Inadequate	.95	.75	NA	Plus addition of ½ mile fence and ½ water facility per section.
	Reseed	1.60	.75	NA	Plus addition of 1 mile fence and 1 water facility per section.
Planned Grazing Systems	Adequate	.95	.75	NA	Plus addition of ½ mile fence and ½ water facility per section.
	Inadequate	1.15	.75	NA	Plus addition of 1 mile fence and 1 water facility per section.
	Reseed	1.60	.75	NA	Plus addition of 1 mile fence and 1 water facility per ¼ section.
Mechanical Treatment2/	Adequate	1.54	.82	$ .72	Establishment costs of $10 per acre amortized over 50 years at 7% interest. Maintenance costs prorated at 2/3 of Proper Grazing Use and 1/3 of Planned Grazing Systems.
	Inadequate	1.74	1.02	.72	
	Reseed	2.32	1.60	.72	
Range Seeding	Adequate	3.42	.82	2.60	Establishment costs of $36 per acre amortized over 50 years at 7% interest. This cost allows for seeding failure in 20% of the efforts.
	Inadequate	3.62	1.02	2.60	
	Reseed	4.20	1.60 3/	2.60	

1/ Maintenance figured at $.75 per acre with fence at $1,200 per mile and water facilities at $1,500 each. Costs of fence and water facilities amortized over 50 years at 7 percent interest.
2/ Includes pitting, contour furrowing, renovation and range interseeding.
3/ Assumes that adequate fencing was done under Continuous Proper Use or Planned Grazing Systems.

Irrigation development costs were calculated on the basis of: major elements of water distribution costs; development costs of the delivery system; and operation, maintenance and repair costs. The most popular distribution system is the center pivot sprinkler system which will usually irrigate about 133 acres. This system was used to establish average distribution costs. Water requirements were estimated at 1.5 acre-feet per acre. Electricity was assumed as the power source, at a cost of 2½ cents per kilowatt hour. The cost of delivering water to a distribution system varies widely from site to site, reflecting variation in vertical and horizontal distance from the water source. Two sets of conditions were assumed for purposes of setting forth alternatives within the LP. The first condition is that the delivery system must lift the water up to 125 feet vertically and one mile or less horizontally. This type system would be feasible for a single operation and a single center pivot system for 133 acres. The second condition is that the delivery system lifts the water 450 feet vertically and transports it four miles to a distribution system. This type development is assumed to be adapted only to larger areas. Average costs were computed on the basis of six center pivots or 798 acres. Water requirement assumptions are the same for both conditions.

A summary comparison of the two conditions appears in Table C-11. Based on water limitations an estimated 267,000 acres are considered potentially feasible for irrigation development. About 32,000 acres could be developed under Condition 1 and the remaining 235,000 acres under Condition 2.

Net Revenue

Figure C-1 shows that all of the activities described thus far converge on the capability of the LP to compute net revenue for any combination of the described variables. Complete displays of this data appear in Appendices E, F and G.

Constraints on Conversion

Table 1 of Chapter 4 sets forth the constraints applied to solution types I through V. Solution type I runs as processed for the current situation and the year 2000 were essentially totally constrained in that all land use and management was manually prespecified. Total crop production and soil loss were results of the prespecification. There were no demand requirements or soil loss constraints levied. However, as footnoted in that table constraints to land use conversion were included in the prespecified conditions for the year 2000. The following tables show the land use conversion constraints that were operative for all runs concerned with future time frames for all types of solutions.

Table C-11 -- IRRIGATION DEVELOPMENT AND OPERATING COSTS

Element of Cost		Development Conditions: Condition 1, 133 Ac. 125' lift, 1 mile distance		Condition 2, 798 Ac. 450' lift, 4 miles distance	
Distribution Costs:					
Capital Costs	(Average Annual)	$3,800 2/		$3,800 2/	
Power	(Average Annual)	1,600		1,600	
Maintenance 1/	(Average Annual)	700		700	
Total	(Average Annual)	$6,100		$6,100	
Total	(Average Annual)/Acre		$45.86		$45.86
Delivery Costs:					
Capital Costs	(Average Annual)	$2,235 3/		$32,970 4/	
Power	(Average Annual)	1,100		19,950	
Maintenance	(Average Annual)	500		5,400	
Total	(Average Annual)	$3,835		$58,320	
Total	(Average Annual)/Acre		$28.83		$73.08
Total Development	(Average Annual)/Acre		$74.69		$118.94

1/ General repairs including labor.
2/ Capital cost per center pivot system of $36,000 amortized over 15 years at 6 3/8 percent interest.
3/ Total capital investment of $34,190 amortized over 60 years at 6 3/8 percent interest.
4/ Total capital investment of $504,500 amortized over 60 years at 6 3/8 percent interest.

Table C-12 contains the upper acreage limits to conversion of range to nonirrigated cropland. These constraints are specific to the antecedent land treatment conditions of adequately treated, inadequately treated and range needing reseeding. The constraints to such conversion are listed by future time frame within county groups and range SRG groups.

Conversions of nonirrigated crop to pasture use and pasture use to nonirrigated cropland use within future time frames are listed in Table C-13. These upper limits to conversion are shown by cropland SRG's within county groups. Constraints to the conversion of nonirrigated cropland acreage to reseeded range use within future time frames appear in Table C-14. Upper limits to conversion are listed in application to range SRG groups within county groups. Table C-15 is the final listing of land use conversion constraints. These are concerned with the conversion of nonirrigated cropland to irrigated cropland under the two irrigation development conditions previously discussed. They are presented in application to cropland SRG's within county groups.

Soil Loss Constraint

Systems capability for constraining soil loss included five levels separately applicable to wind or water as causal agents. These controls ranged through 1, 2, 3, 5 and 7 tons per acre per year. Solution type IV constrained soil loss due to wind and water at two tons per acre per year for cropland, pasture and range-forest SRG's.

Production Constraint

Demand constraints for major crops as input to the linear programming model for application to Solution Type II are the products of disaggregation of projected state production to the study area level. Future production levels as derived for the state and hence the study area are known as OBERS projections. Several sets of projections have been developed which reflect differences in basic assumptions with regard to such factors as rate of population growth, level of employment, rate of technological progress, etc. Additional assumptions have been made in application to subsequent series of projections in relation to such elements as domestic consumption, rate of population growth and foreign export level. These projections represent levels of production, consumption, exports and resource use that could occur given the underlying assumptions, rather than targets to be achieved by existing governmental policies and programs.

Table C-12 -- CONSTRAINTS TO CONVERSION OF RANGE TO NONIRRIGATED CROPLAND

County Group	Range SRG Group	Acreage of Current Treatment Needs			Upper Limit of Conversion Constraint											
					1985				2000				2020			
		A1/	I2/	R3/	A	I	R	Total	A	I	R	Total	A	I	R	Total
1	312	43,100	118,600	700	8,600	23,700	100	32,400	18,900	52,200	300	71,400	34,500	94,400	600	129,500
	332	407,600	1,678,800	8,000	48,600	153,400	1,000	203,000	107,000	337,600	2,200	446,800	194,500	613,600	4,000	812,100
	343	27,400	77,800	0	1,300	4,000	0	5,300	2,900	8,700	0	11,600	5,300	15,800	0	21,100
	362	220,000	696,700	0	7,200	17,700	0	24,900	15,800	38,900	0	54,700	28,700	70,700	0	99,400
	382	489,600	995,000	1,700	23,400	44,400	100	67,900	51,600	97,700	200	149,500	93,800	177,600	300	271,700
	393	0	1,800	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		1,187,700	3,568,700	10,400	89,100	243,200	1,200	333,500	196,200	535,100	2,700	734,000	356,800	972,100	4,900	1,333,800
2	311	51,700	36,400	0	10,300	7,300	0	17,600	11,800	16,000	0	38,800	41,400	29,100	0	70,500
	321	641,400	655,200	0	76,500	78,300	0	154,800	168,400	171,700	0	340,100	306,000	314,200	0	620,200
	343	36,600	58,300	0	1,800	2,900	0	4,700	4,000	6,400	0	10,400	7,300	11,700	0	19,000
	351	1,170,100	191,900	0	28,300	5,500	0	33,800	62,100	12,100	0	74,200	113,000	21,900	0	134,900
	371	526,900	635,800	0	25,600	30,900	0	56,500	56,400	68,000	0	124,400	102,600	123,700	0	226,300
	393	11,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		2,437,700	1,577,600	0	142,500	124,900	0	267,400	313,700	274,200	0	587,900	570,300	500,600	0	1,070,900
3	311	700	900	0	100	200	0	300	300	500	0	800	500	900	0	1,400
	321	37,200	322,700	21,800	5,100	45,800	4,100	55,000	11,700	100,800	9,000	121,500	21,100	193,400	16,300	230,800
	343	0	13,500	0	0	700	0	700	0	1,500	0	1,500	0	2,700	0	2,700
	351	236,900	428,500	0	1,800	13,900	0	15,700	4,000	30,700	0	34,700	7,200	55,900	0	63,100
	371	2,700	5,600	0	100	0	0	100	300	0	0	300	500	100	0	600
	393	0	1,900	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		277,300	773,100	21,800	7,100	60,600	4,100	71,800	16,300	133,500	9,000	158,800	29,300	253,000	16,300	298,600

(Continued)

Table C-12 -- CONSTRAINTS TO CONVERSION OF RANGE TO NONIRRIGATED CROPLAND (Continued)

County Group	Range: SRG Group	Acreage of Current Treatment Needs			Upper Limit of Conversion Constraint											
					1985				2000				2020			
		A1/	I2/	R3/	A	I	R	Total	A	I	R	Total	A	I	R	Total
4	311	39,300	73,000	15,800	7,800	14,600	3,100	2,500	17,300	32,100	6,900	56,300	31,400	58,400	12,600	102,400
	321	839,400	1,156,300	63,300	102,900	161,200	9,700	273,800	226,900	354,300	21,400	602,600	412,300	644,600	38,900	1,095,800
	343	43,800	51,600	0	2,200	4,800	0	7,000	4,800	10,500	0	15,300	8,800	19,100	0	27,900
	351	1,034,000	932,700	25,100	22,600	29,500	1,200	53,300	49,600	65,100	2,700	117,400	90,300	118,200	4,900	213,400
	371	45,300	135,500	0	1,100	4,600	0	5,700	2,400	10,100	0	12,500	4,300	18,400	0	22,700
	382	46,000	3,700	0	0	0	0	0	0	0	0	0	0	0	0	0
	393	2,600	600	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		2,050,400	2,353,400	104,200	136,600	214,700	14,000	365,300	301,000	472,100	31,000	804,100	547,100	858,700	56,400	1,462,200
5	312	86,200	81,700	3,400	17,200	16,300	700	34,200	38,000	36,000	1,500	75,500	69,000	65,400	2,700	137,100
	332	315,800	871,700	12,900	29,500	85,500	1,500	116,500	65,100	197,100	3,100	265,300	118,500	358,400	5,400	482,300
	343	49,000	84,200	100	2,400	4,200	0	6,600	5,300	9,300	0	14,600	9,700	16,900	0	26,600
	362	226,000	420,500	8,200	5,300	9,200	200	14,700	11,900	20,300	300	32,500	21,500	37,000	600	59,100
	382	59,300	155,500	13,500	400	4,000	0	4,400	800	8,900	0	9,700	1,500	16,100	0	17,600
	393	19,500	5,900	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		755,800	1,619,500	38,100	54,800	119,200	2,400	176,400	121,100	271,600	4,900	397,600	220,200	493,800	8,700	722,700
Basin Total		6,708,900	9,892,300	174,500	430,100	762,600	21,700	1,214,400	948,300	1,686,500	47,600	2,682,400	1,723,700	3,078,200	86,300	4,888,200

1/ Adequately treated.
2/ Inadequately treated.
3/ Reseeding needed.

Table C-13 -- CONSTRAINTS TO LAND USE CONVERSIONS

County Group	SRG No.	CNI Acreage		Upper Limit of Conversion Constraint					
		Nonirr. Crop Totals	Pasture Total	Nonirrigated Crop to Pasture			Pasture to Nonirrigated Crop		
				1985	2000	2020	1985	2000	2020
		Acres							
1	022	207,300	10,100	2,400	5,500	9,900	700	2,100	5,000
	042	107,100	10,000	1,300	2,800	5,100	700	2,000	5,000
	062	28,900	1,400	1,800	4,000	7,300	200	400	600
	082	16,700	0	200	400	800	0	0	0
	102	31,700	2,800	1,900	4,400	8,000	500	800	1,300
	122	90,500	32,100	5,500	12,500	22,800	5,500	9,700	15,100
	152	34,000	9,300	1,500	3,300	6,000	700	1,800	3,400
	172	6,000	1,200	400	800	1,500	0	400	600
	192	5,800	1,700	400	800	1,400	300	500	800
	203	12,200	1,900	100	300	600	100	400	1,000
	212	20,500	8,300	900	2,000	3,600	600	700	3,100
	222	14,200	7,500	600	1,400	2,500	500	1,500	2,800
	232	9,200	0	400	900	1,600	0	0	0
	242	54,700	15,800	2,300	5,300	9,700	1,100	3,200	5,800
	252	6,700	0	300	600	1,200	0	0	0
	262	8,700	0	0	0	0	0	0	0
	273	2,600	0	0	0	0	0	0	0
	282	7,300	0	0	0	0	0	0	0
	293	200	0	0	0	0	0	0	0
Total		664,000	102,100	20,000	45,000	82,000	10,900	23,500	44,200

(continued)

Table C-13 -- CONSTRAINTS TO LAND USE CONVERSIONS (continued)

County Group	SRG No.	CNI Acreage: Nonirr. Crop Totals	CNI Acreage: Pasture Total	Upper Limit of Conversion Constraint: Nonirrigated Crop to Pasture 1985	Nonirrigated Crop to Pasture 2000	Nonirrigated Crop to Pasture 2020	Pasture to Nonirrigated Crop 1985	Pasture to Nonirrigated Crop 2000	Pasture to Nonirrigated Crop 2020
		Acres							
2	011	99,100	5,900	1,400	3,100	5,600	0	0	0
	031	315,000	4,700	4,400	9,800	17,900	0	0	0
	051	368,300	12,100	12,400	27,300	49,700	0	0	0
	071	100	3,400	0	0	0	0	0	0
	091	16,300	0	200	500	900	0	0	0
	111	20,000	0	300	600	1,100	0	0	0
	131	11,000	5,700	400	800	1,500	0	0	0
	141	81,600	0	2,700	6,100	11,000	0	0	0
	161	1,600	0	100	100	200	0	0	0
	181	10,200	0	300	800	1,400	0	0	0
	191	3,600	0	100	300	500	0	0	0
	203	4,500	0	100	100	200	0	0	0
	211	25,400	0	1,100	2,500	4,500	0	0	0
	221	12,700	0	600	1,200	2,300	0	0	0
	231	4,000	0	200	400	700	0	0	0
	241	171,100	8,500	7,500	16,700	30,400	0	0	0
	251	4,100	0	200	400	700	0	0	0
	261	8,700	0	0	0	0	0	0	0
	281	300	0	0	0	0	0	0	0
	293	200	0	0	0	0	0	0	0
Total		1,157,800	40,300	32,000	70,700	128,600	0	0	0

(continued)

Table C-13 -- CONSTRAINTS TO LAND USE CONVERSIONS (continued)

County Group	SRG No.	CNI Acreage		Upper Limit of Conversion Constraint					
				Nonirrigated Crop to Pasture			Pasture to Nonirrigated Crop		
		Nonirr. Crop Totals	Pasture Total	1985	2000	2020	1985	2000	2020
		Acres							
3	011	55,900	0	0	100	200	0	0	0
	031	84,600	4,500	100	200	300	800	1,900	3,500
	051	31,700	0	100	200	400	0	0	0
	071	140,700	28,100	100	200	400	1,800	11,600	22,000
	091	118,600	900	100	200	400	200	400	700
	111	312,600	16,600	200	500	900	3,100	6,900	13,000
	131	224,800	18,800	700	1,400	2,600	2,800	3,800	5,600
	141	300	0	0	0	0	0	0	0
	161	114,400	2,500	300	700	1,300	300	500	800
	181	96,000	0	300	600	1,100	0	0	0
	191	900	0	0	0	0	0	0	0
	203	11,600	0	0	0	0	0	0	0
	211	40,700	0	300	600	1,000	0	0	0
	221	34,000	0	200	500	900	0	0	0
	231	31,900	0	200	500	800	0	0	0
	241	17,300	0	100	200	400	0	0	0
	251	2,400	0	0	0	100	0	0	0
	261	25,900	0	0	0	0	0	0	0
	281	5,100	0	0	0	0	0	0	0
	293	100	0	0	0	0	0	0	0
Total		1,349,200	71,400	2,700	5,900	10,800	9,000	25,100	45,600

(continued)

Table C-13 -- CONSTRAINTS TO LAND USE CONVERSIONS (continued)

County Group	SRG No.	CNI Acreage: Nonirr. Crop Totals	CNI Acreage: Pasture Total	Upper Limit of Conversion Constraint: Nonirrigated Crop to Pasture 1985	2000	2020	Pasture to Nonirrigated Crop 1985	2000	2020
		---------------	-------	Acres	-------	-------	-------	-------	---------------
4	011	313,200	13,100	1,500	5,400	6,200	700	2,700	6,100
	031	168,500	12,100	800	1,800	3,300	700	2,500	5,700
	051	68,700	8,500	2,100	4,700	8,500	1,700	2,500	3,400
	071	180,200	9,000	900	1,900	3,500	500	1,800	4,200
	091	69,900	19,000	400	800	1,400	1,000	3,900	8,900
	111	184,200	6,700	900	2,000	3,600	400	1,400	3,200
	131	144,800	5,000	4,500	9,900	18,000	1,000	1,500	2,000
	141	22,300	3,600	700	1,500	2,800	700	1,100	1,400
	161	42,300	5,300	1,300	2,900	5,100	1,100	1,600	2,100
	181	65,200	11,600	2,000	4,400	8,100	2,300	3,500	4,700
	191	21,500	2,500	700	1,500	2,700	500	700	1,000
	203	7,100	2,300	0	100	100	100	500	1,100
	211	56,000	3,400	2,000	4,400	8,000	300	700	1,000
	221	40,800	3,000	1,500	3,200	5,800	300	600	900
	231	59,900	1,000	2,100	4,700	8,500	100	200	300
	241	31,000	3,600	1,100	2,400	4,400	400	700	1,100
	251	2,700	0	100	200	400	0	0	0
	261	19,600	0	0	0	0	0	0	0
	273	500	0	0	0	0	0	0	0
	281	3,600	0	0	0	0	0	0	0
	293	100	0	0	0	0	0	0	0
Total		1,502,300	109,700	22,600	49,800	90,500	11,800	25,900	47,100

(continued)

Table C-13 -- CONSTRAINTS TO LAND USE CONVERSIONS (continued)

County Group	SRG No.	CNI Acreage: Nonirr. Crop Totals	CNI Acreage: Pasture Total	Upper Limit of Conversion Constraint: Nonirrigated Crop to Pasture 1985	2000	2020	Pasture to Nonirrigated Crop 1985	2000	2020
		Acres							
5	022	45,300	4,400	1,400	3,000	5,500	200	500	600
	042	34,700	400	1,000	2,300	4,200	0	0	0
	062	15,700	600	1,200	2,700	4,900	0	0	100
	082	18,400	200	600	1,200	2,200	0	0	0
	102	12,200	1,600	900	2,100	3,800	0	200	400
	122	70,800	14,400	5,500	12,100	22,100	100	1,500	3,100
	152	16,600	100	1,500	3,200	5,800	0	0	0
	172	2,400	800	200	400	700	0	100	200
	192	1,000	0	100	200	300	0	0	0
	203	6,900	1,900	200	500	800	0	200	300
	212	16,700	5,600	1,500	3,200	5,900	100	300	900
	222	5,000	900	400	1,000	1,800	0	100	100
	232	9,800	4,600	900	1,900	3,400	0	200	700
	242	6,100	1,900	500	1,200	2,100	0	100	300
	252	300	700	0	0	100	0	0	100
	262	21,900	400	0	0	0	0	0	0
	273	4,600	0	0	0	0	0	0	0
	282	2,600	100	0	0	0	0	0	0
	293	3,400	0	0	0	0	0	0	0
Total		294,200	38,500	15,900	35,000	63,600	400	3,200	6,800
Basin Total		4,967,500	362,000	93,200	206,400	375,500	32,100	77,700	143,700

Table C-14 -- CONSTRAINTS TO CONVERSION OF NONIRRIGATED CROPLAND TO RESEEDED RANGE

County Group	Range SRG Group	Range Needing Reseeding	Upper Limit of Conversion Constraint 1985	2000	2020
		Acres			
1	312	700	9,100	21,200	38,500
	332	8,000	36,500	80,400	146,200
	343	0	600	1,300	2,400
	362	0	11,800	15,800	21,500
	382	1,700	12,500	15,800	20,700
	393	0	200	200	200
Total		10,400	70,700	134,700	229,500
2	311	0	4,900	10,900	19,800
	321	0	80,300	176,700	318,800
	343	0	200	500	900
	351	0	18,700	25,800	33,100
	371	0	34,500	75,600	137,200
	393	0	200	200	200
Total		0	138,800	289,700	510,000
3	311	0	2,800	6,200	11,200
	321	21,800	98,100	216,300	393,000
	343	0	600	1,300	2,300
	351	0	25,900	58,800	85,900
	371	0	8,500	12,700	18,900
	393	0	100	100	100
Total		21,800	136,000	295,400	511,400
4	311	15,800	15,600	34,400	62,600
	321	63,300	84,800	184,500	335,700
	343	0	300	800	1,400
	351	25,100	43,300	71,700	114,500
	371	0	6,700	14,100	25,300
	382	0	3,200	3,200	3,200
	393	0	0	0	0
Total		104,200	153,900	308,700	428,200
5	312	3,400	2,300	5,000	9,100
	332	12,900	22,400	48,700	92,300
	343	100	300	800	1,400
	362	8,200	23,900	26,300	29,900
	382	13,500	8,400	9,900	12,100
	393	0	3,400	3,400	3,400
Total		38,100	60,700	94,100	148,200
Basin Total		174,500	560,100	1,122,600	1,827,300

Table C-15 -- CONSTRAINTS TO CONVERSION OF NONIRRIGATED CROPLAND TO IRRIGATED CROPLAND[1/]

County Group	SRG No.	CNI Acreage		Upper Limit of Conversion Constraint					
		Nonirrigated Cropland	Irrigated Cropland	Irrigation Condition 1[2/]			Irrigation Condition 2[3/]		
				1985	2000	2020	1985	2000	2020
		Acres							
1	022	192,600	14,700	920	1,610	1,830	2,865	8,020	13,465
	042	97,500	9,600	460	810	930	1,450	4,060	6,815
	082	14,300	2,400	70	120	140	215	600	1,010
	102	31,500	200	150	260	300	470	1,320	2,210
Total		335,900	26,900	1,600	2,800	3,200	5,000	14,000	23,500
2	011	99,100	900	550	970	1,105	2,875	8,050	13,510
	031	315,000	1,800	1,760	3,070	3,515	9,150	25,620	43,000
	091	16,300	200	90	160	180	475	1,330	2,240
Total		420,400	2,900	2,400	4,200	4,700	12,500	35,000	58,750
3	011	55,900	0	630	1,100	1,260	3,450	9,650	16,200
	031	84,600	0	950	1,670	1,910	5,210	14,600	24,510
	071	140,700	2,100	280	490	560	1,540	4,310	7,240
	091	118,500	200	1,340	2,340	2,670	7,300	20,440	34,330
Total		399,700	2,300	3,200	5,600	6,400	17,500	49,000	82,250
4	011	313,200	10,400	2,400	4,200	4,790	4,280	11,985	20,115
	031	168,500	1,400	1,290	2,250	2,580	2,300	6,440	10,810
	071	180,200	600	540	940	1,075	960	2,690	4,510
	091	69,900	1,300	1,370	2,410	2,755	2,460	6,885	11,565
Total		731,800	13,700	5,600	9,800	11,200	10,000	28,000	47,000
5	022	45,300	21,000	1,310	2,300	2,630	2,050	5,740	9,635
	042	34,700	1,900	1,010	1,760	2,010	1,570	4,400	7,380
	082	18,400	3,400	350	610	700	550	1,540	2,585
	102	12,200	2,500	530	930	1,060	830	2,320	3,900
Total		110,600	28,800	3,200	5,600	6,400	5,000	13,000	23,500
Basin Total		1,998,400	74,600	16,000	28,000	31,900	50,000	139,000	235,000

1/ Constraints to conversion are fixed at zero for all unlisted SRG's.
2/ Center pivot system irrigating 133 acres with water supply within one mile horizontally and 125 feet vertically.
3/ Cluster of center pivot systems irrigating 798 acres with water supply within four miles horizontally and 450 feet vertically.

For purposes of establishing level of projected production for inclusion as a constraint in the generation of type II solutions, disaggregated OBERS E' projections were developed. These projections, as well as OBERS E" projections, are more fully discussed in Appendix B, Economic Base and Projections. The object of employing these projected production levels as "targets" was to observe the behavior of the model in terms of effects on such parameters as land use conversions, soil loss, net revenue and regional economic effects.

Solution types I through V were further processed through use of a report writer program which carried out the process of summarization of solution elements.

Input-Output Model

A Leontief input-output (I-O) model was developed to analyze the regional economic impacts of the alternative presented in this study. The key to Leontief's system is the construction of the input-output or transactions table which shows the flow of commodities from each of the producing sectors in the basin to all other consuming sectors, both intermediate and final.

The model developed for this study was constructed from the non-survey, secondary data method. The non-survey approach uses existing secondary data and several assumptions in a computer model to develop the transactions table. It is a relatively simple and fast method to develop a model.

Secondary Data Used to Build the Western South Dakota Model

1. The 1967 National I-O model was used as the basic transactions table.

2. The total sales by each industrial sector in the Western South Dakota Basin were used to reduce the National Model.

3. The third set of data used in building the I-O model was an estimate of the region's domestic final demand, or sales to in-Basin consumers.

Assumptions

The following assumptions were made in building the Western South Dakota I-O model:

1. It was assumed the production function (input-output relationship) is the same in Western South Dakota as the average national production function in the National I-O Model.

2. If a production input was not available in Western South Dakota, it could be imported from the rest of the nation.

3. If a sector could not meet all demands for its products, all purchasing sectors (including final demand) import equal to the proportion of product they are buying from the deficient sector.

4. A sector in the region cannot produce products which are imported by the national economy in any larger proportion than is exhibited in the National model.

5. When regional sectors and domestic final demand does not purchase the entire output of a sector, the residual production of that sector is assumed exported.

The Western South Dakota Model

The main difference between the Western South Dakota model and the National model is the lack of sectors. The region has somewhat the same economic activity (buying and selling between industries) except fewer industries to participate. The required goods and services needs for production by the sectors in the regional economy, that is not being produced in the region, are imported. These imports can be classified into competitive and non-competitive. The non-competitive imports are those from industries not represented in the region. Competitive imports are from industries that are represented in the region, but the regional industry is not large enough to supply all goods and services required.

The competitive and non-competitive imports are subtracted from the national production function leaving those goods and services purchased by industries in the region from production within the region. Thus, a Western South Dakota transactions table was developed.

Impacts

Once the model was developed, matrix algebra was employed to multiply the production associated with each alternative in the study by the relationship in the model. The results were a prediction of several economic indicators (employment, income, gross regional product and total sales) associated with the alternative.

Direct, indirect and induced effects were calculated. Direct effects are in the agriculture sectors, indirect effects involve sectors that supply factors of production to the agriculture sectors, and induced effects bear on the economy of the employees and owners spending their money in the region.

The economic indicators are employment, income, gross regional product and total sales. Employment is measured in person-years of employment. Income is the payment to the household sector for services rendered to the industry. Gross regional product is the value of the region's contribution to production of all goods and services in the region.

The output per employee was assumed to increase by 1½ percent per year for agriculture sectors and 1 percent per year for non-agriculture sectors. Prices were held constant at 1977 prices for all time periods.

The exact numerical impact, calculated from a secondary data model, may be suspect. However, the relative difference between alternative management strategies is a consistent estimate on which one can place a high degree of confidence.

METHODOLOGY FOR WILDLIFE EVALUATION

APPENDIX D

Methodology for Wildlife Evaluation

Explanation of Terms

Farmland Wildlife

Includes animals that frequent croplands, pastures, meadows, and planted woodlands. Although these wildlife use other areas, such as naturally wooded lands and heavily vegetated marshlands, they are most closely associated with the cultured areas. Examples of this kind of wildlife are pheasant, gray partridge, mourning dove, cottontail, jackrabbit, fox, racoon, and whitetail deer.

Rangeland Wildlife

Includes animals that occur on areas maintained in native plant communities, normally referred to as range. Areas of range frequently include wooded draws, wooded alluvial lands, areas of farming, and some planted woodland. The occurrence of range, however, is the major habitat element affecting wildlife. Examples of this kind of wildlife are mule deer, whitetail deer, antelope, jackrabbit, coyote, sharp-tailed grouse, horned lark, lark bunting, and mourning dove.

Land Use Factor

The habitat value of a composite of planned land uses for a kind of wildlife, expressed in hundredths. Management differences are not considered.

Quality Factor

The composite habitat value of a planned complex of cropland rotations and grassland management systems for a kind of wildlife, expressed in hundredths. Management differences tied to land uses are the considerations.

Percent Developed for Wildlife

The degree to which lands have a development potential for wildlife.

Acre Value for Wildlife

The product of the total planned acres and the degree (percent) to which this total has a development potential for wildlife.

Evaluation Worksheets

Wildlife evaluation factors and the basis for a wildlife evaluation is discussed in Chapter 4. These discussions of Chapter 4, and the process of making the evaluation, are extended into Chapter 5.

The following pages are completed worksheets for wildlife habitat evaluations that were conducted for Farmland Wildlife - 1975 Prespecified Conditions, and Rangeland Wildlife - 1975 Prespecified Conditions. These are the worksheets that were used to perform the evaluations for the two kinds of wildlife, involving the five alternatives.

Wildlife Habitat Evaluation

Farmland Wildlife

Name of Alternative: 1975 Prespecified Conditions

Percent Developed for Farmland Wildlife: 50%

Acre Value for Farmland Wildlife: 11,350,635

Analysis

Land Use Factor

Table A
Land Use

Land Use	Acres	Percent
Cropland (Dry)	3,926,670	17.3
Cropland (Irr.)	125,444	0.6
Hayland (Perm.)	971,388	4.3
Pastureland (Perm.)	362,072	1.6
Rangeland	17,315,696	76.2
Total	22,701,270	100.0

Table B
Habitat Value Factor

Land Use	Percent Land Use and Value Factor									
	0	.1-.5	.6-.9	1-6	7-12	13-25	26-50	51-75	76-90	90+
Cropland (Dry)	0	0	.1	.3	.5	.7	1.0	.7	.5	.1
Cropland (Irr.)	0	.4	.7	1.0	.6	.5	.3	.2	.1	.1
Hayland (Perm.)	0	0	.1	.4	.6	.8	1.0	.8	.5	.1
Pastureland (Perm.)	0	0	.1	.2	.4	.6	.7	.6	.4	.1
Rangeland	0	0	.1	.3	.5	.7	1.0	.7	.5	.1

Table C
Acre Value

Land Use	Acres	X Value	Acre Value
Cropland (Dry)	3,926,670	.7	2,748,669
Cropland (Irr.)	125,444	.7	87,811
Hayland (Perm.)	971,388	.4	388,555
Pastureland (Perm.)	362,072	.2	72,414
Rangeland	17,315,696	.5	8,657,848
Totals	22,701,270	-	11,955,297

$$\frac{\text{Total Acre Value (Table C)}}{\text{Total Land Use Acres (Table A)}} = \text{Land Use Factor}$$

$$\frac{11,955,297}{22,701,270} = .53$$

Quality Factor

Table D
Cropland (Dry)

Rotations	Acres	X Quality	= Acre Value
1A	3,073	.9	2,766
1B	18,900	.8	15,120
2A	630,402	.7	441,281
2B	241,812	.7	169,268
3A	164,479	.5	82,240
3B	24,199	.4	9,680
40	83,664	.3	25,099
50	367,517	.1	36,752
60	875,364	.2	175,073
7A	262,486	.6	157,492
7B	442,524	.6	265,514
80	472,508	.6	283,505
99	339,742	.5	169,871
Total	3,926,670	Total	1,833,661

Table E
Cropland (Irr.)

Rotations	Acres X	Quality =	Acre Value
I1	17,459	.6	10,475
I2	75,687	.3	22,706
I3	32,298	.5	16,149
Total	125,444	Total	49,330

Table F
Hayland (Perm.)

Acres X	Quality =	Acre Value
971,388	.5	485,694

Table G
Pastureland (Perm.)

Mgt. Systems	Acres X	Quality =	Acre Value
A	253,450	.1	25,345
B	90,518	.6	54,311
C	18,104	.8	14,483
Z	—	.1	—
Total	362,072	Total	94,139

Table H
Rangeland

Mgt Systems	Acres X	Quality =	Acre Value
A	--	.4	—
B	7,806,747	.2	1,561,349
C	8,852,554	.7	6,196,788
D	72,031	.8	57,625
E	--	.6	—
F	1,348	.5	674
G	180,138	.8	144,110
H	357,600	.7	250,320
I	1,974	.6	1,184
Z	43,304	.1	4,330
Total	17,315,696	Total	8,216,380

Acre Value

Table I

Acre Values

Land Use	Acres-Table A	Acres-Tables D, E, F, G, H
Cropland (Dry)	3,926,670	1,833,661
Cropland (Irr.)	125,444	49,330
Hayland (Perm.)	971,388	485,694
Pastureland (Perm.)	362,072	94,139
Rangeland	17,315,696	8,216,380
Totals	22,701,270	10,679,204

$$\frac{\text{Total Acre Value (Table I)}}{\text{Total Land Use Acres (Table A)}} = \text{Quality Factor}$$

$$\frac{10,679,204}{22,701,270} = .47$$

Percent Developed
Total Acre Value

Land Use Factor (Table C) + Quality Factor (Table I) ÷ 2 provides a Quality Factor when expressed as a decimal, and the Percent Developed for Farmland Wildlife as a percentage.

$.53 + .47 \div 2 = .50$

The percent developed, or the quality factor, X the total acres (Table A) provides the Total Acre Value for Farmland Wildlife.

$22,701,270 \times .5 = 11,350,635$

Wildlife Habitat Evaluation

Rangeland Wildlife

Name of Alternative: 1975 Prespecified Conditions

Percent Developed for Rangeland Wildlife: 62%

Acre Value for Rangeland Wildlife: 14,074,787

Analysis

Land Use Factor

Table A
Land Use

Land Use	Acres	Percent
Cropland (Dry)	3,926,670	17.3
Cropland (Irr.)	125,444	0.6
Hayland (Perm.)	971,388	4.3
Pastureland (Perm.)	362,072	1.6
Rangeland	17,315,696	76.2
Total	22,701,270	100.0

Table B
Habitat Value Factor

Land Use	Percent Land Use and Value Factor									
	0	.1 - .5	.6 - .9	1 - 6	7 - 12	13-25	26-50	51-75	76-90	90+
Cropland (Dry)	.5	.7	.9	1.0	.7	.3	.1	0	0	0
Cropland (Irr.)	.6	.8	1.0	1.0	.7	.3	.1	0	0	0
Hayland (Perm.)	0	0	0	0	0	0	.1	.3	.5	.3
Pastureland (Perm.)	0	0	.1	.3	.5	.3	.1	0	0	0
Rangeland	0	0	0	0	0	.1	.3	.7	1.0	.9

Table C
Acre Value

Land Use	Acres	X Value	Acre Value
Cropland (Dry)	3,926,670	.3	1,178,001
Cropland (Irr.)	125,444	1.0	125,444
Hayland (Perm.)	971,388	0	0
Pastureland (Perm.)	362,072	.3	108,622
Rangeland	17,315,696	1.0	17,315,696
Totals	22,701,270		18,727,763

$$\frac{\text{Total Acre Value (Table C)}}{\text{Total Land Use Acres (Table A)}} = \text{Land Use Factor}$$

$$\frac{18,727,763}{22,701,270} = 0.82$$

Quality Factor

Table D
Cropland (Dry)

Rotations	Acres	X Quality	= Acre Value
1A	3,073	.5	1,536
1B	18,900	.2	3,780
2A	630,402	.6	378,241
2B	241,812	.6	145,087
3A	164,479	.5	82,240
3B	24,199	.4	9,680
40	83,664	.3	25,099
50	367,517	.1	36,752
60	875,364	.2	175,073
7A	262,486	.7	183,740
7B	442,524	.5	221,262
80	472,508	.6	283,505
99	339,742	.5	169,871
Total	3,926,670	Total	1,715,806

Table E
Cropland (Irr.)

Rotations	Acres	X Quality	= Acre Value
I1	17,459	.4	6,984
I2	75,687	.8	60,550
I3	32,298	.6	19,379
Total	125,444	Total	86,913

Table F
Hayland (Perm.)

Acres	X Quality	= Acre Value
971,388	.5	485,694

Table G
Pastureland (Perm.)

Mgt. Systems	Acres	X Quality	= Acre Value
A	253,450	.2	50,690
B	90,518	.5	45,259
C	18,104	.7	12,673
Z	---	.1	---
Total	362,072	Total	108,622

Table H
Rangeland

Mgt. Systems	Acres	X Quality	= Acre Value
A	---	.4	---
B	7,806,747	.3	2,342,024
C	8,852,554	.5	4,426,277
D	72,031	.6	43,219
E	---	.7	---
F	1,348	.4	539
G	180,138	.8	144,110
H	357,600	.7	250,320
I	1,974	.5	987
Z	43,304	.3	12,991
Total	17,315,696	Total	7,220,467

Acre Value

Table I

Acre Values

Land Use	Acres–Table A	Acres–Tables D, E, F, G, H
Cropland (Dry)	3,926,670	1,715,866
Cropland (Irr.)	125,444	86,913
Hayland (Perm.)	971,388	485,694
Pastureland (Perm.)	362,072	108,622
Rangeland	17,315,696	7,220,467
Totals	22,701,270	9,617,562

$$\frac{\text{Total Acre Value (Table I)}}{\text{Total Land Use Acres (Table A)}} = \text{Quality Factor}$$

$$\frac{9,617,562}{22,701,270} = 0.42$$

Percent Developed
Total Acre Value

Land Use Factor (Table C) + Quality Factor (Table I) ÷ 2 provides a Quality Factor when expressed as a decimal, and the Percent Developed for Rangeland Wildlife as a percentage.

$$0.82 + 0.42 \div 2 = 0.62$$

The percent developed, or the quality factor, X the total acres (Table A) provides the Total Acre Value for Rangeland Wildlife.

$$0.62 \times 22,701,270 = 14,074,787$$